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RUBBER WORLD

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tents, page 640

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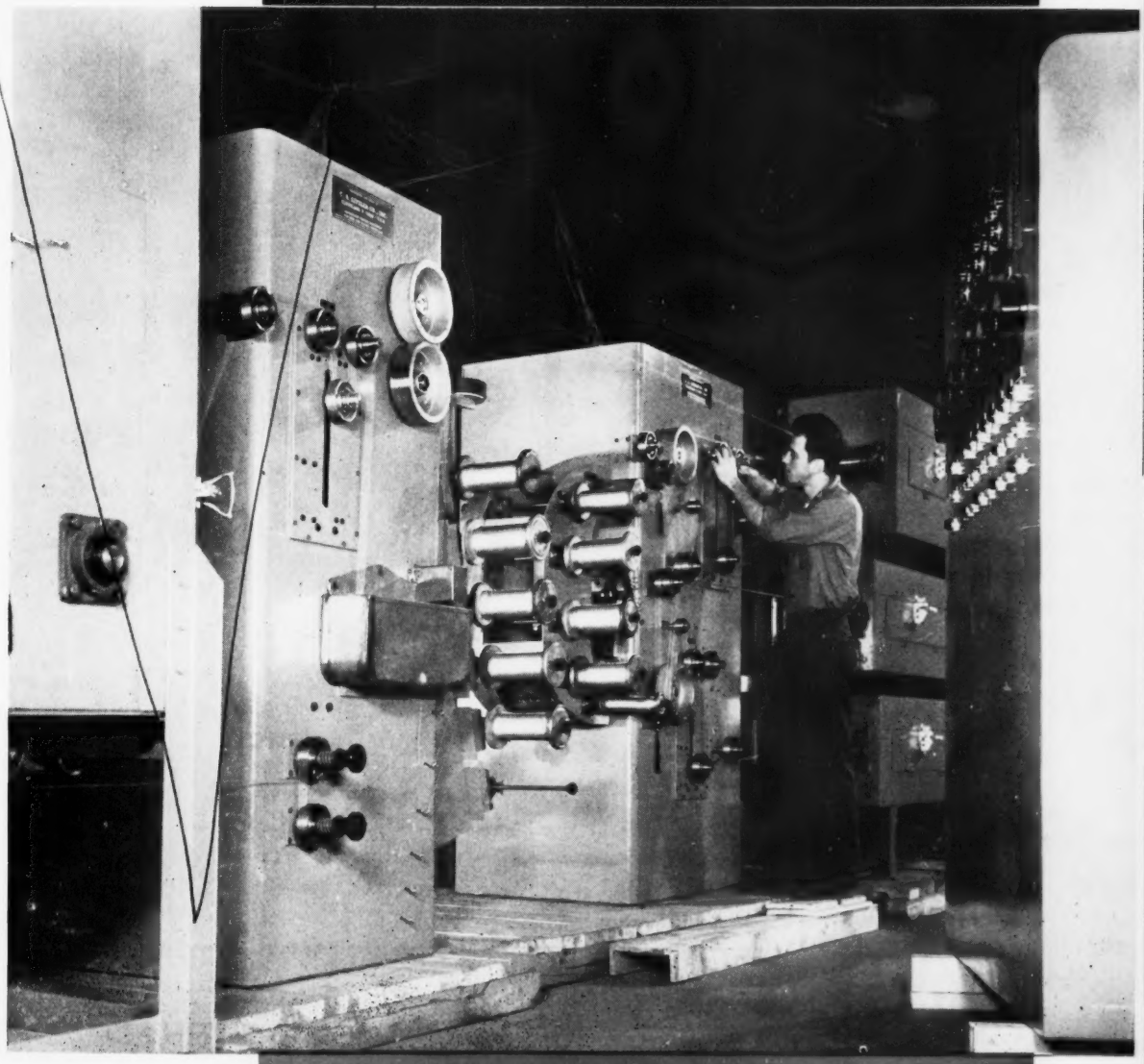
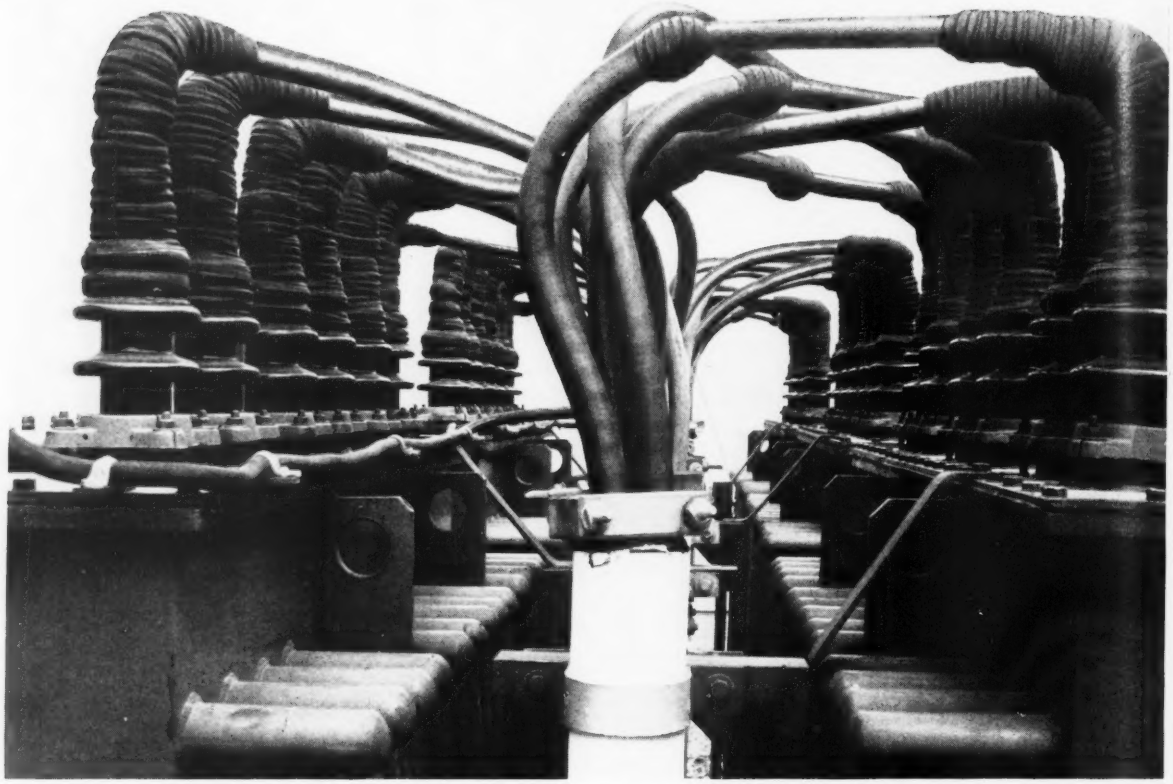


BILL BROTHERS

UBLICATION

ASSEMBLING FIVE-END COMPUTREATER

Page 701



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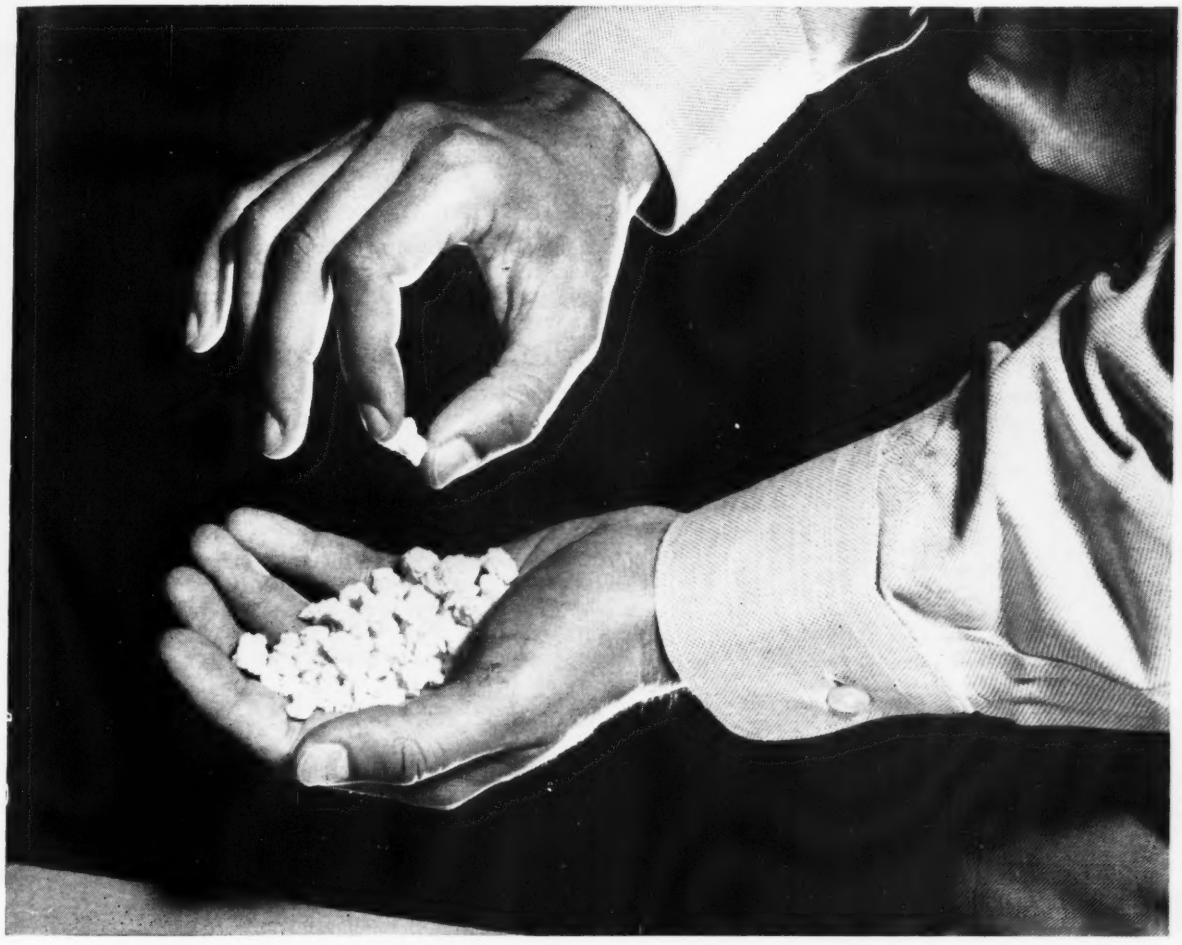

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with new Good-rite 2057 in "popcorn" form

NEW Good-rite 2057, in dustless, free-flowing "popcorn" form, is a ready-to-use, equally proportioned master batch of cold GR-S and Good-rite 2007 (RESIN 50). Its unique form permits processing as received.

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ARTICLE HIGHLIGHTS

MOONEY VISCOSITY RELATED TO MOLDING

Using Mooney's original derivations and data on compounded butyl rubber, a chart of Mooney gage readings *versus* fill rate and molding temperature has been developed for molded electrical products. **695**

NEW, VERSATILE PILOT-UNIT CORD TREATER

A new single- or multiple-end cord treater for determining optimum tire cord processing conditions and also useful for continuous supervision of quality control has been developed. **701**

REQUIREMENTS FOR 1958 CENSUS OF MANUFACTURES

The proposed new product section for form MC-30A, "Rubber and Related Products," for the 1958 Census of Manufactures for the rubber industry includes commodity inquiries on both rubber and plastics products. It should be used as planned in order to evaluate both the rubber and plastics industries more completely than ever before. **693**

VULCANIZATION OF SILICONE RUBBERS

Specific advantages as well as disadvantages have been found for several peroxide vulcanizing agents when used in dimethyl siloxane and vinyl methyl siloxane copolymers. **711**

ADHESION AND ADHESIVES COVER WIDE FIELD

Rosin and derivatives for pressure-sensitive uses, and adhesives in tires, shoes, flooring are covered. **718**

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VOLUME 137, NUMBER 5 FEBRUARY, 1958

CONTENTS

1958 CENSUS SHOULD REPORT ON BITH RUBBER AND PLASTICS
An editorial by R. G. Seaman 693

MOONEY VISCOSITY AS RELATED TO MOLDED ELECTRICAL PRODUCTS
A. A. Kessel 695

NEW SINGLE-END CORD TREATER—THE COMPUTREATER 701

VULCANIZATION OF SILICONE RUBBER
J. R. Harper, A. D. Chipman, and G. M. Konkle 711

SOUTHERN RUBBER GROUP SYMPOSIUM ON ADHESION

Rubber Adhesion, with Emphasis on Rosin and Derivatives in Pressure-Sensitive Adhesives
Frank H. Wetzel 718

Latex Tire-Cord Adhesives
E. Leonard Borg 723

Cover Photo: Courtesy of C. A. Litzler Co., Inc.

The opinions expressed by our contributors do not necessarily reflect those of our editors

FEATURE DEPARTMENTS

Letters to the Editor	644	News from Abroad	749
News of the Rubber World	717	New Equipment	752
Meetings and Reports	718	New Materials	754
Calendar of Coming Events	728	New Products	756
Washington Report	731	Book Reviews	760
Industry News	734	New Publications	762
News Briefs	742	Market Reviews	770
News About People	744	Statistics	774
Obituaries	748	Advertisers Index	787

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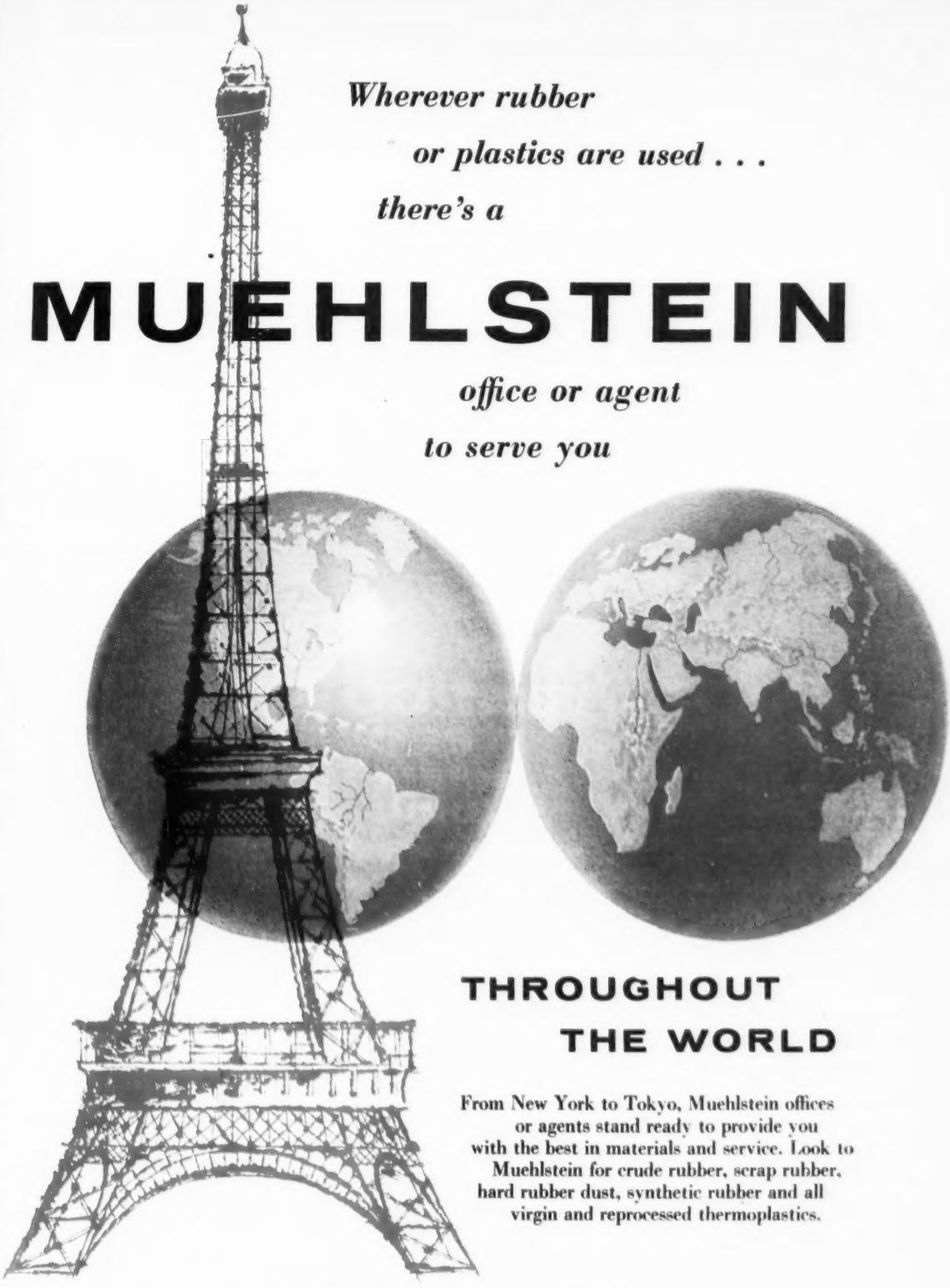

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Letters to the Editor

More on Perforated Pages

DEAR SIR:

The idea of perforating all but the advertising pages of RUBBER WORLD is an exceedingly good one, and I would like to see it continue. As a matter of fact, I hope the idea spreads to other technical magazines.

H. D. SCHMIDT
Stowe-Woodward, Inc.,
Newton Upper Falls, Mass.

DEAR SIR:

Since I am rather well known for my habit of removing pages with a helpful or interesting message to the reader from all magazines, you can be sure I appreciate the new service rendered by RUBBER WORLD.

I hope you will continue to use this method of perforation in the future—I am very happy with the idea, and I know many of your readers will be too.

R. J. DORN
President
The Barr Rubber Products Co.,
Sandusky, O.

DEAR SIR:

We note with chagrin that you are now scoring the inside margin of your pages for easier removal.

While this is very convenient for persons who wish to remove articles, it is very difficult for libraries which bind the journal. Not only do we have to replace the issues at the end of the year, but the scoring makes it very difficult for the binder to do a satisfactory job.

C. ALICE RANKIN
Librarian
Nopco Chemical Co.,
Harrison, N. J.

DEAR SIR:

In answer to your request for comments regarding the scored pages in the December issue of RUBBER WORLD, I would like to thank you for this added service. It is very helpful and much appreciated.

W. L. ENGLAND
Sales Manager
Phoenix Mfg. Co.,
Rubber Products Division,
Joliet, Ill.

DEAR SIR:

This is with reference to your request for readers' comments on the new feature of scored pages.

I feel the innovation is a good one except for those pages that contain technical articles, since having the pages scored might make it difficult to bind the magazines for permanent reference.

F. S. ROSTLER
Golden Bear Oil Co.,
Los Angeles, Calif.

In these five Standard Units are all the necessary components to control effectively the degradation mechanisms that take place in polyvinyl chloride resins on aging, during heat processing or on exposure to sunlight. They are widely used alone and in combinations for specific effects in clear and opaque stocks. Their advantages have been proven over other tested materials, such as those based on tin (which frequently decolorizes effects of degradation without correcting them) or on lead (which frequently contributes to oxidation and breakdown on aging). We also supply combinations of components selected from these five Standard Units, to correct special conditions encountered in each Vinyl Processing Industry.

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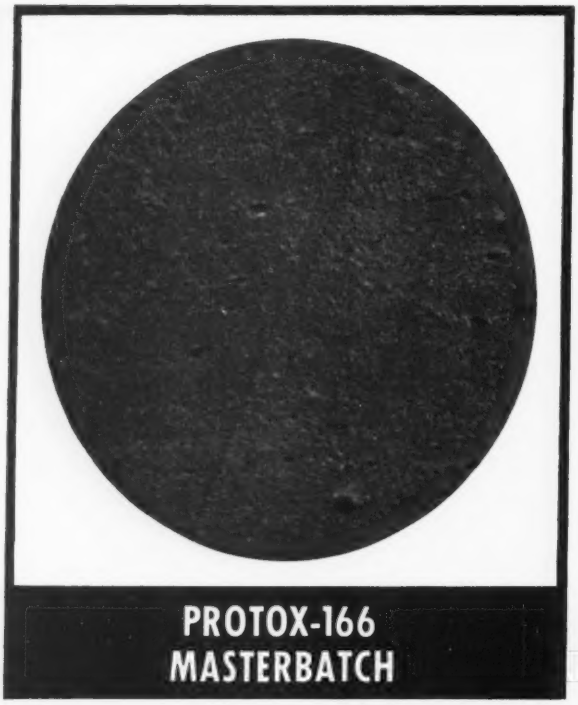
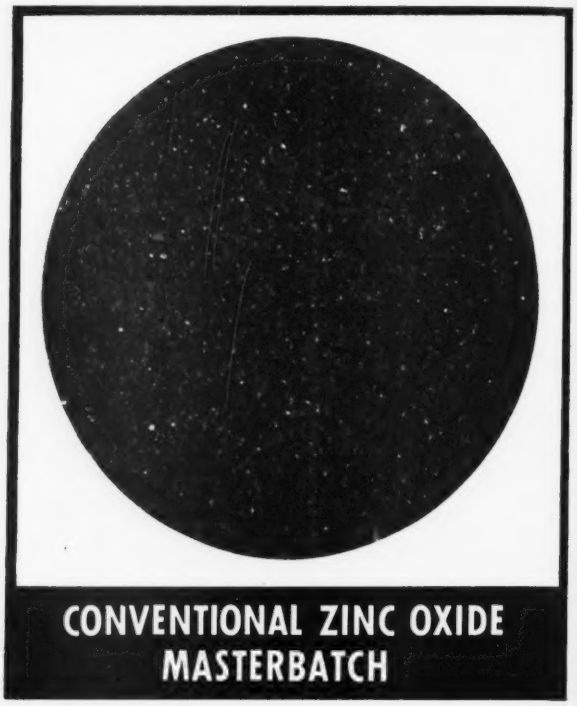


PROTOX-166
MASTERBATCH



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3. **Protox-166 particles are readily wet by all types of rubbers.**

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HORSE HEAD PRODUCTS ®

Photo courtesy of the New Jersey Rubber Company, Taunton, Mass.

One thing all America is soled on

The first steps in the development of a synthetic shoe sole were taken in the early 1930's. It was introduced commercially shortly after World War II. Since that time, this lightweight, waterproof, long-wearing blend of synthetic rubber and resin has grown in acceptance to where it is now used on just about 65% of all shoes of all types produced in these United States. And its use is still spreading.

Constant improvement in both raw materials and compounding techniques has been the key to the success of these soles. It's also the reason why PLIOFLEX rubber and PLIOLITE S-6B, the reinforcing resin by Goodyear, are so widely used by sole manufacturers.

The main advantage of PLIOFLEX in shoe soles is its unusually light color and high uniformity. With PLIOLITE S-6B, the advantages lie in superior processability and reinforcing properties. And with both materials, there's unmatched technical assistance and service.

If you are looking for top-quality shoe soles or any rubber product where hardness, stiffness, or toughness properties are important, be sure you have the full story on PLIOFLEX and PLIOLITE S-6B. It's yours simply by writing Goodyear, Chemical Division, Dept. N-9418, Akron 16, Ohio.

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Chemigum, Plioflex, Pliolite, Plio-Tuf, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

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It used to be that "O"-ring failures were all too frequent. Ordinary rubber could not withstand the various hydraulic fluids, the −40° F. to 160° F. temperatures, the flexing, the stretching, the elongation. But the picture changed when Goodyear introduced CHEMIGUM—first of the truly oil-resistant rubbers.

The unique composition of CHEMIGUM soon made possible "O"-rings with an absolute minimum of swell or shrinkage, excellent resistance to heat and cold, very low compression set and maximum squeeze combined with minimum friction. And its easy processing permitted meeting tolerances in the very low thousandths of an inch.

Perhaps the fate of your product also can be assured a success by CHEMIGUM. For full details plus the finest in technical service, just write to

Goodyear, Chemical Division
Dept. N-9418, Akron 16, Ohio

GOODYEAR

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Chemigum, Plioflex, Pliolite, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

What styrene resin for reinforcing synthetic rubber?

The charts reproduced at right represent just some of the reasons for reinforcing styrene rubber with PLIOLITE S-6B.

Besides its decided improvement of physical properties in general, PLIOLITE S-6B offers two other major benefits. First, it serves as a processing aid. And second, it functions as an indirect cost-cutter.

PLIOLITE S-6B works as a processing aid by acting as a plasticizer at elevated temperatures to provide smooth-running, easy-flowing stocks of reduced nerve. It also improves mold reproduction and minimizes warpage and shrinkage of extruded goods.

PLIOLITE S-6B helps cut costs by permitting lighter-weight stocks and/or the use of larger amounts of fillers. It also makes possible substantial economies in mixing, forming and curing, reduces rejects and permits easier work-away of cured scrap.

You'll also find a number of other advantages to compounding styrene rubber with PLIOLITE S-6B. Details plus the latest *Tech Book Bulletins* are yours by writing to:

Goodyear, Chemical Division, Akron 16, Ohio

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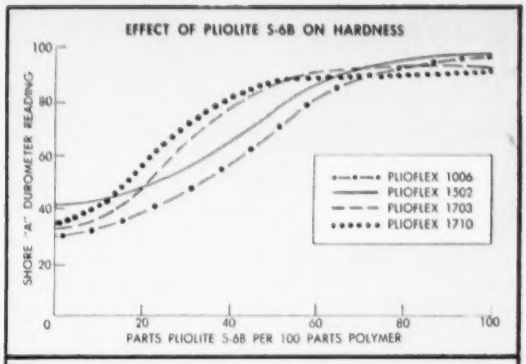
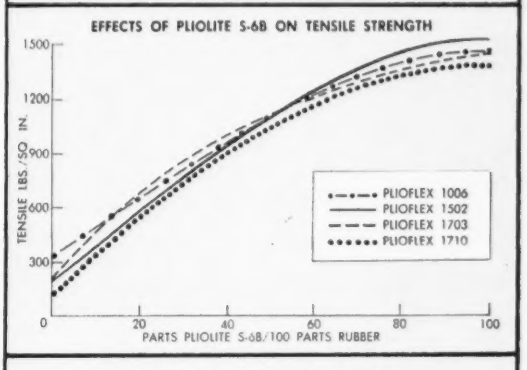
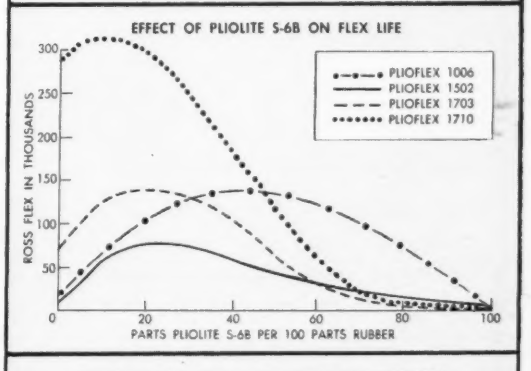
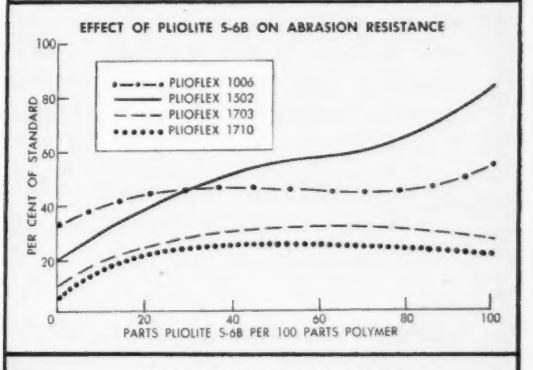
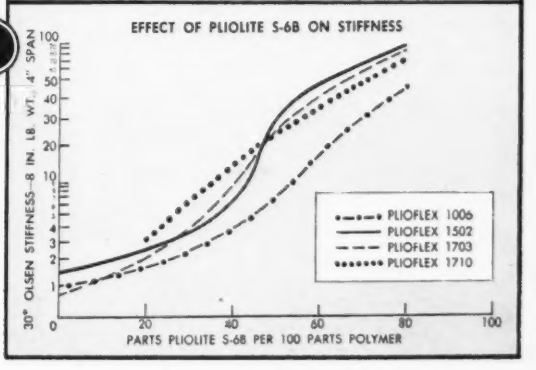


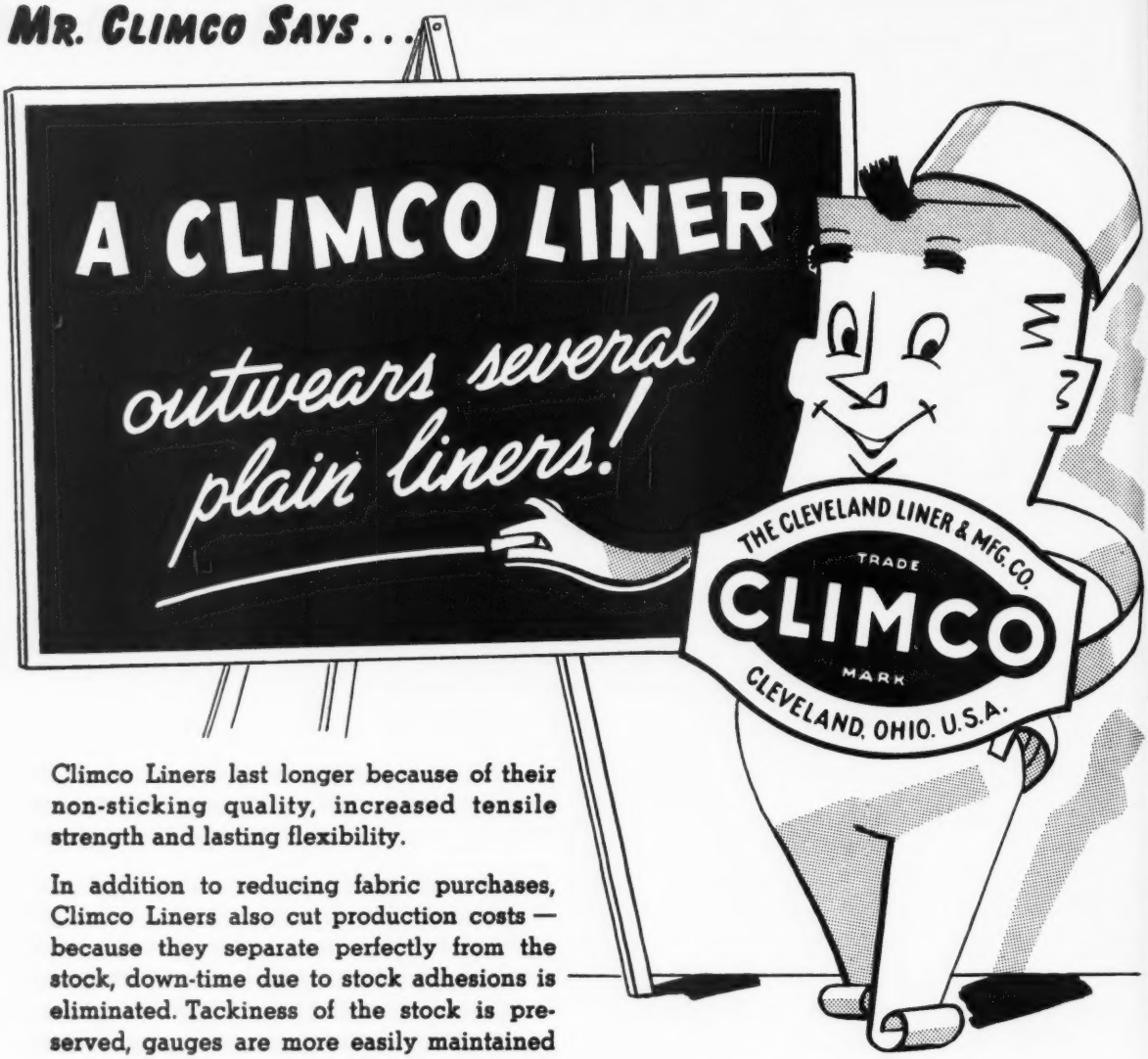







EFFECT OF PLIOLITE S-6B ON STIFFNESS
30° OLSEN STIFFNESS—8 IN. LB. WT. 4" SPAN
PARTS PLIOLITE S-6B PER 100 PARTS POLYMER
PLIOFLEX 1006
PLIOFLEX 1502
PLIOFLEX 1703
PLIOFLEX 1710

MR. CLIMCO SAYS . . .



Climco Liners last longer because of their non-sticking quality, increased tensile strength and lasting flexibility.

In addition to reducing fabric purchases, Climco Liners also cut production costs — because they separate perfectly from the stock, down-time due to stock adhesions is eliminated. Tackiness of the stock is preserved, gauges are more easily maintained and latitude in compounding is enlarged. There is no lint or ravelings with Climco Liners and they can be stored horizontally if desired.

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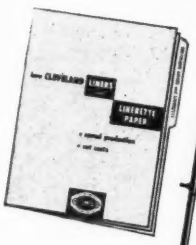

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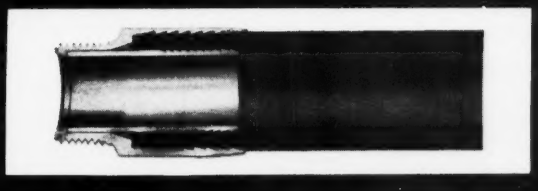
A CONTINUING ECONOMY WITH PERMANENTLY-ATTACHED COUPLINGS. Hidden expenses—time, paper work, packing, shipping, etc.—involved in reconditioning of re-attachable couplings eliminated.

A MACHINE-ATTACHMENT ASSURES A MORE PERFECT FIT. Permanently-attached couplings are machine-fitted by experts. You get a permanently fitted coupling every time.

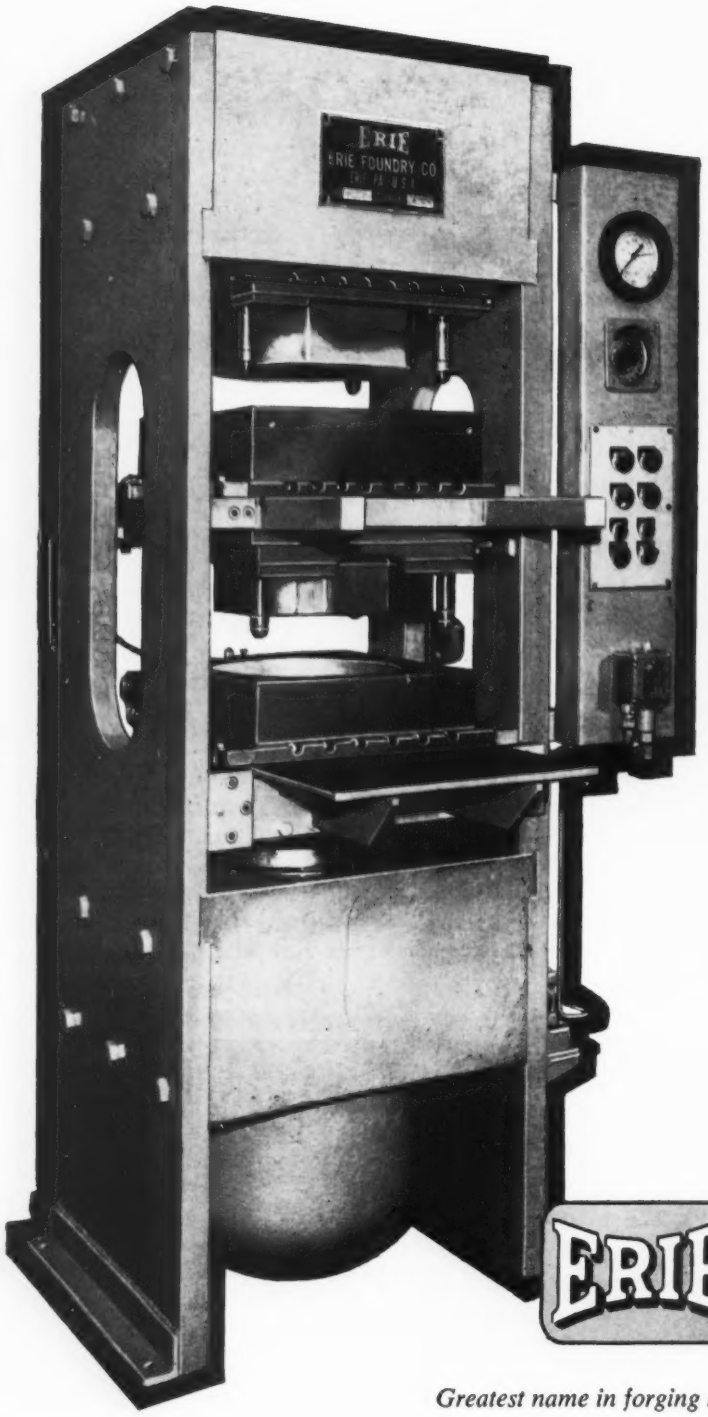
A LEAK-PROOF WITH FULL-FLOW DIAMETER INSIDE. Scovill permanently-attached couplings are made from solid brass forgings with ductile copper-alloy flow tubes to form a strong leak-proof assembly.

For gasoline-pump hose . . . permanently-attached hose couplings by **SCOVILL**



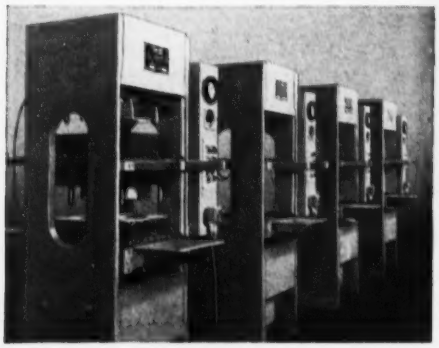
For complete specifications on gasoline-pump hose couplings, write to Scovill Manufacturing Co., Merchandise Division, 99 Mill St., Waterbury 20, Conn. Ask for Bulletin No. 570-H.

this ERIE press "stands out" for low-cost molding



If you're molding plastics or thermo-setting materials, you can boost profits by including Erie presses like these in your operation. Of side plate construction, with two 15" openings, this machine is up-acting, has a 14" main ram with a 16" stroke.

Semi-automatic in operation, this Erie press features a die-slide arrangement and accurate action that holds scrap loss to absolute minimums. Low maintenance costs and overall savings in operation make these presses ideal for any compression molding operation.



The battery of presses shown above is employed in a precision plastics operation (the owner commented, incidentally, that they are "performing better than the manufacturer stated"). This battery is powered by a high and low pressure accumulator system which was built by Erie Foundry. The presses are available with self-contained pumping units.

We'll be glad to give you full details on this press. Or let us help you with any press problem. There's no obligation. Just call or write...

ERIE FOUNDRY CO.
ERIE 8, PA.

ERIE

Greatest name in forging machinery and hydraulic presses—since 1895

The rubber you want—at the time you need it!

The most comprehensive warehouse service in the synthetic rubber industry is now provided by TEXUS. It offers many outstanding features to help you plan production schedules...economically. These include:

- **overnight delivery in most cases**
- **lower on-hand inventory**
- **lower in-transit inventory**
- **truckload quantities at no premium**
- **emergency shipments**

To make it possible for you to take full advantage of these service features, TEXUS is now operating complete SYNPOL warehouse operations at the following strategic locations:

Providence	**Chicago**
Edgewater, N. J.	**Los Angeles**
Akron	**Port Neches, Texas**

This warehouse service is just one more indication of TEXUS superiority as a source of supply.

Remember, for the widest variety of clear rubbers, when you want them, and packaged to meet your needs —TURN TO TEXUS.

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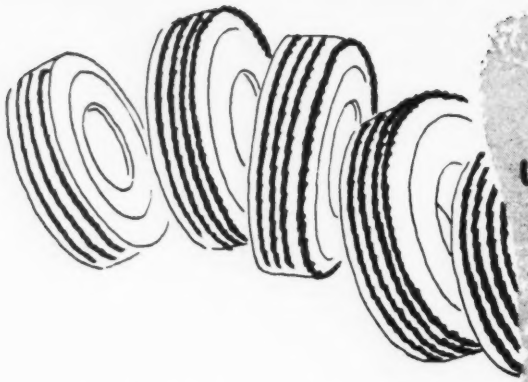
260 Madison Avenue, New York 16, N. Y.

Sales Agent: Naugatuck Chemical, Naugatuck, Conn.

Plants and General Offices: Port Neches, Texas



"when I said, 'no ozone cracking ever' that clinched the sale!"

UOP 88 and 288

antiozonants help salesmen make sales

When your salesmen go out to sell to your dealers . . . when your dealers' salesmen sell to consumers . . . UOP 88 and 288 antiozonants give your tires these plus factors that help them rack up more sales:

- Positive, built-in protection against ozone cracking, weather checking. Not just coated protective, UOP 88 and 288 form an impregnable *chemical barrier* against ozone attack . . .
- Pre-mold addition of UOP antiozonants 88 and 288 improve the rubber in the tire . . .
- Tire life is extended. No matter what the time lag between manufacture and consumer use of your product, it will be in prime condition, will give longer, better consumer satisfaction . . .
- No special handling of tires is needed. UOP 88 and 288 antiozonants are a part of the tire . . . won't chip off, crack, or peel—ever. The protection outlasts the tread.

The reputation of your company rides on every tire you make. UOP 88 and 288 help you protect that reputation, give your salesmen "an edge" when it comes to writing the order.

UOP 88® and 288
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UNIVERSAL OIL PRODUCTS COMPANY

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MAKE THE TAPE THAT FORMS A PERFECT SKIN

Wrap a fully cured tape of this new silicone rubber around a cable . . . in a short time it fuses into a homogeneous mass! Press a molded or extruded piece of this rubber into position and it will stay firmly in place. From research at UNION CARBIDE, the Silicones Man brings you the world's first *fusible*, silicone rubber.

This new product has all the properties usually associated with premium silicone rubber . . . outstanding high temperature performance, good electrical and oil resistance, excellent reversion resistance among them. You can well imagine the many applications in electronics gear, high temperature locations . . . how assembly work will be speeded by "press-in-place" construction. Here is another example of how the specialized knowledge of the Silicones Man has helped solve an "impossible" problem.

Write for data on "Fusible Silicone Rubber" or any of the many other silicones products available through the Silicones Man. Address Dept. RW-2, Silicones Division, Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. (*In Canada:* Bakelite Company, Division of Union Carbide Canada Limited, Toronto 7, Ontario)

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Utility, reliability, quality

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The switch to Masterbaches is impressive

It is just good common sense to standardize on **MASTERBATCHES**, especially on **BAYTOWNS**. They simplify warehousing, materials handling and mixing, and result in all-around better economy. They give added mileage to tires and, what is equally important, less cracking.

There are **BAYTOWN MASTERBATCHES** of every description specifically formulated to conform with your needs as to butadiene-styrene polymer, oil extension, emulsifier, stabilizer, type black and loading, and even compounding oil.

BAYTOWN MASTERBATCHES are of outstanding quality for processing and reinforcement. They are ever dependable for uniformity from shipment to shipment.

Be up to date. Go the **MASTERBATCH** way — **BAYTOWN**, of course — and thus join the leaders. For exceptional good results rely on **UNITED**. We will gladly help you.

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ESPESOL 165's Narrow boiling range reduces handling time— improves quality of end product!

NEW ESPESOL 165 aliphatic solvent offers rubber processors a *narrow boiling range of 165 to 225 degrees F* with a low-odor factor. This narrow cut with its low end point offers a much shorter drying time and a substantial increase in production. ESPESOL 165's higher initial boiling point offers less evaporation loss and permits greater solvent recovery. The solvent's unusually short distillation range offers two additional benefits: 1. Improved quality of end products. 2. Reduction in amount of solvent used.

Because the use of ESPESOL 165 can reduce handling time, increase production and improve the quality of your end products, this outstanding new solvent deserves the consideration of your organization. Send for the complete ESPESOL 165 story. Brochure containing characteristics and properties yours free on request. (No delivery problems! Eastern maintains adequate stocks of this unique product at all times.)

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Please send me free booklet on the characteristics and properties of Espesol 165.

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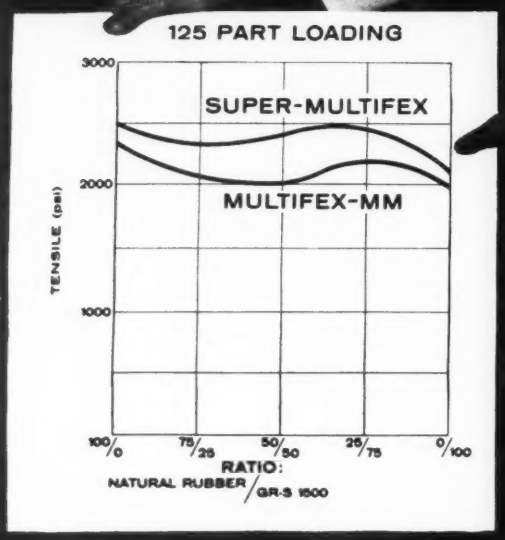
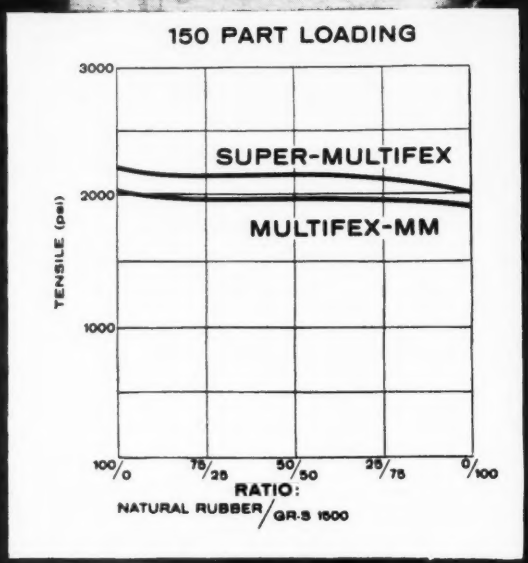
YES, EVEN IN 100% GR-S,

Super-Multifex® maintains 2000 psi tensile strength





Now you can use DIAMOND Super-Multifex in your GR-S compounds—even in those with *no* natural rubber—and be sure you're getting at least 2000 psi tensile strength.

Contrast the performance of Super-Multifex and Multifex-MM® with the much lower tensiles normally obtained in compounds containing ground limestone.

DIAMOND's ultra-fine Super-Multifex (.03 micron) precipitated calcium carbonate has extremely uniform particles, coated to aid dispersion, mixing and processing.

Multifex-MM, also shown on the graphs, is an uncoated, ultra-fine (.04-.06 micron) precipitated calcium carbonate. You can see how it consistently reinforces GR-S, too.

Try either Super-Multifex or Multifex-MM in your next batch to improve physical properties. Call your DIAMOND Representative today. He can supply information and technical help on these and other high-grade calcium carbonates. Or write DIAMOND ALKALI COMPANY, 300 Union Commerce Bldg., Cleveland 14, Ohio.

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SUBSIDIARIES: Adamson United Company, Akron, Ohio
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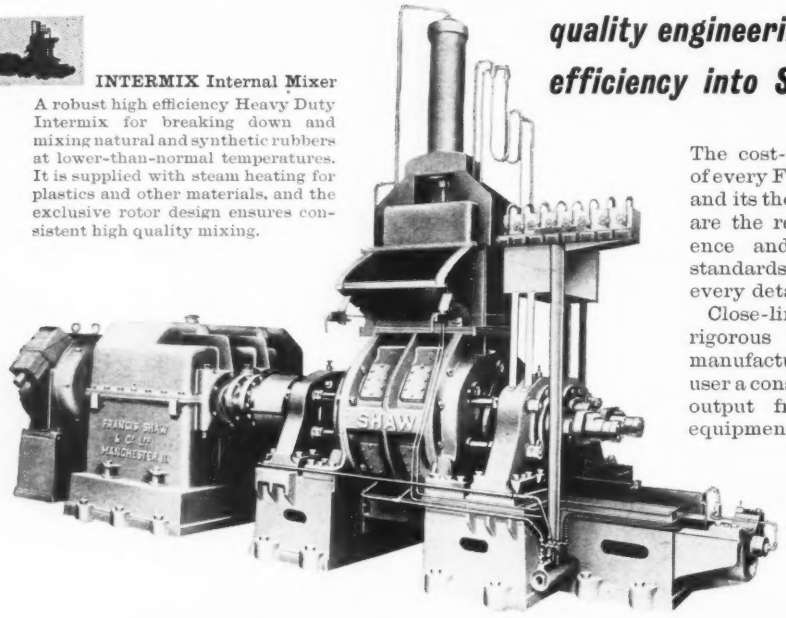
INTERMIX Internal Mixer

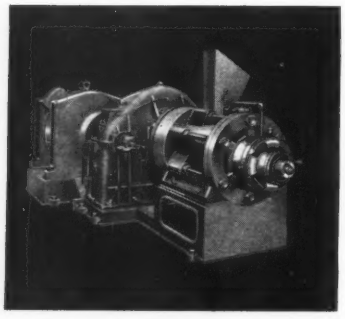
A robust high efficiency Heavy Duty Intermix for breaking down and mixing natural and synthetic rubbers at lower-than-normal temperatures. It is supplied with steam heating for plastics and other materials, and the exclusive rotor design ensures consistent high quality mixing.



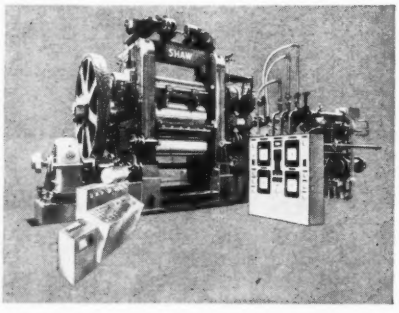
quality engineering puts efficiency into Shaw machines

The cost-cutting performance of every Francis Shaw machine and its thorough dependability are the result of long experience and unvaryingly high standards of engineering in every detail of manufacture.

Close-limit accuracy and rigorous inspection during manufacture guarantee to the user a consistently high quality output from Francis Shaw equipment.



RUBBER EXTRUDER. Variable speed drives, carefully designed flow channels, heat extraction and accurate temperature control are special features of Francis Shaw extruders. Piping, tubing, miscellaneous sections, sheathing and insulating of cables are catered for by the wide selection of die-heads.



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The results of Velsicol's extensive rubber research and process development work are a valuable "premium" that you receive when you contact your Velsicol representative. He not only has the facts about our resins and reclaiming oils, but also has a fund of information that can help you solve your special cost, production, and quality problems. Contact him today!

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- ☐ Please send literature on X-37 resin and custom reclaim oils.
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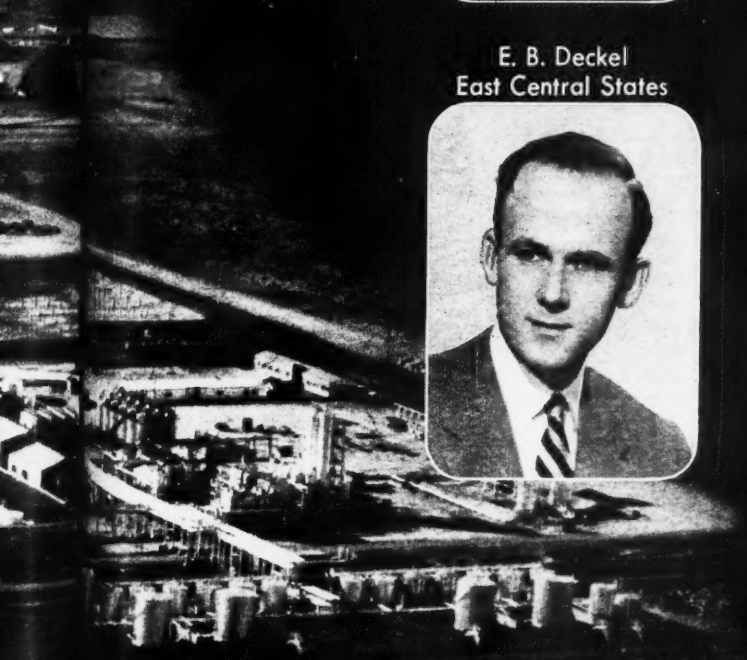

Here's the Gentro-Jet sales team . . . ready to give you the latest information and advantages of this revolutionary new black masterbatch. These men are backed by a highly-qualified, factory-trained technical service staff to provide laboratory and "on-the-spot" factory service.

To put this group to work for you, just drop us a note. You'll see how Gentro-Jet will improve efficiency and products.

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Creating Progress Through Chemistry

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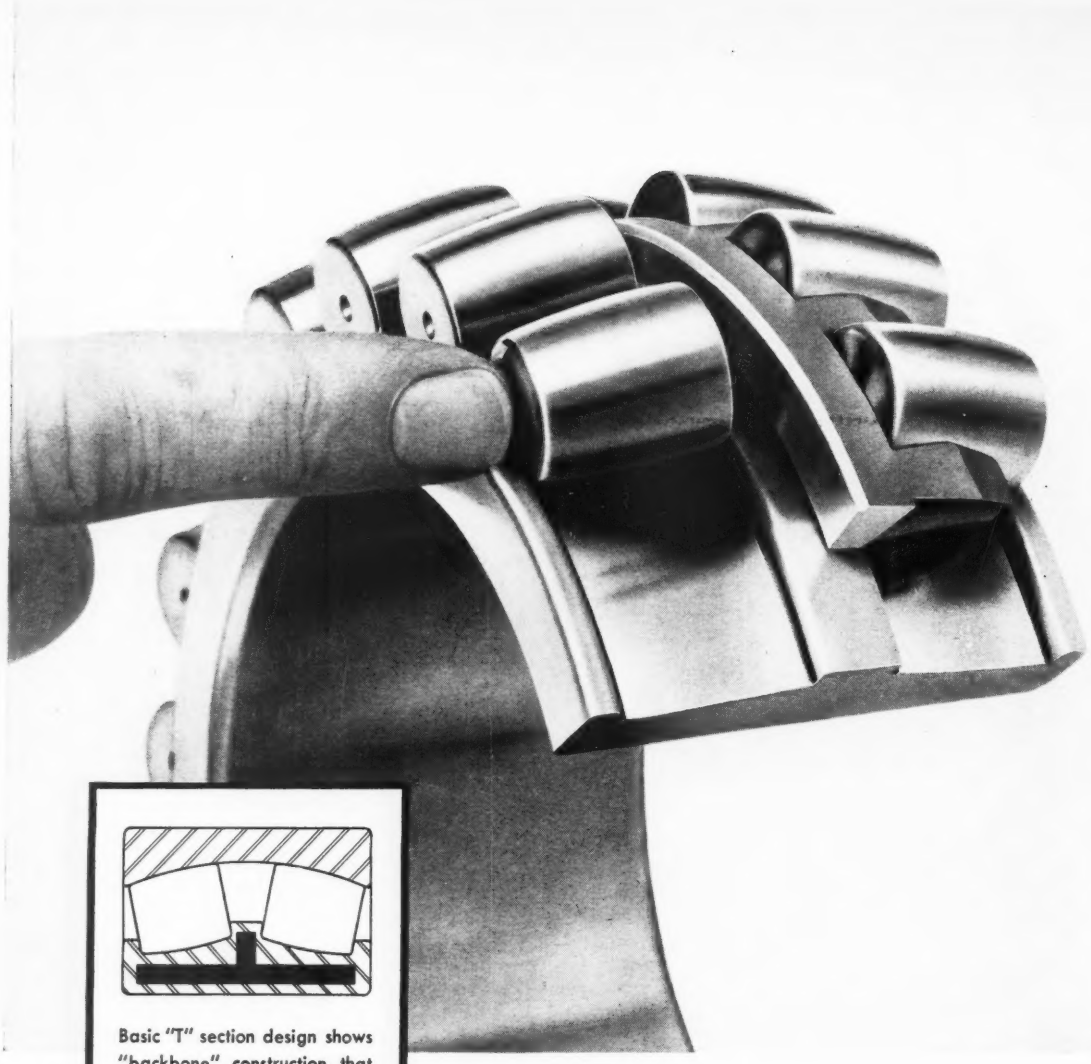
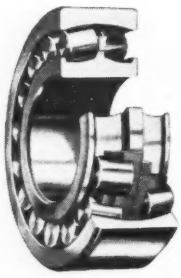


Basic "T" section design shows "backbone" construction that insures positive roller guidance and stability without skewing under all load conditions.



For roller stability...

there's nothing like "the bearing with the backbone"

The only *positive* way to guide rollers is by an integral center guide flange—backbone of the *Torrington* Spherical Roller Bearing. No floating ring can match it for stability under heavy radial and thrust loads.

This "bearing with the backbone" insures true rolling motion . . . prevents stress concentration . . . means minimum friction. It makes possible open-end cage design, too, with no shrouds to impede circulation of lubricant to bearing contact surfaces. There is less heating and more positive lubrication.

The integral center guide flange is adapted from the same principle used in the design of Torrington Tapered Roller Bearings. This refinement is typical of Torrington's uncompromising engineering that assures you the ultimate in bearing performance. **The Torrington Company, South Bend 21, Ind.—and Torrington, Conn.**

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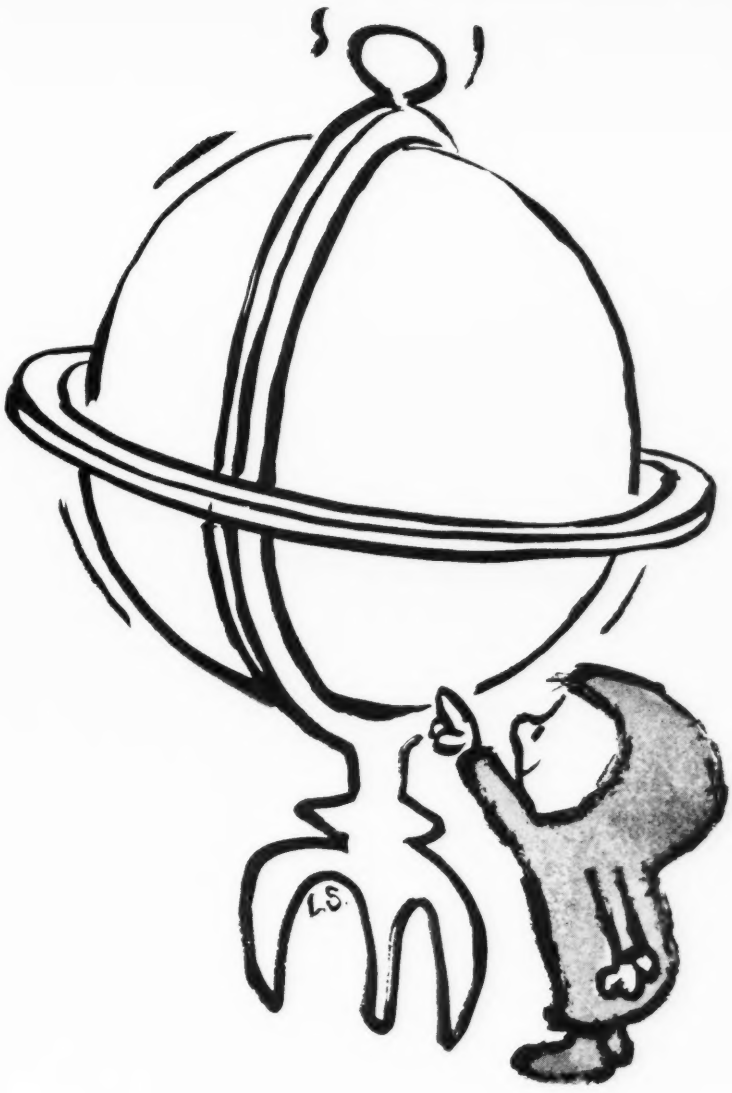
SPHERICAL ROLLER • TAPERED ROLLER • CYLINDRICAL ROLLER • NEEDLE • BALL • NEEDLE ROLLERS • THRUST



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means pioneering in cold rubber...

and pioneering means exploring new areas of
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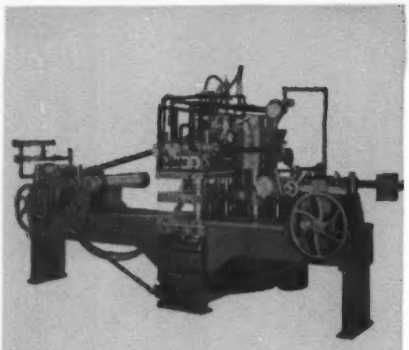
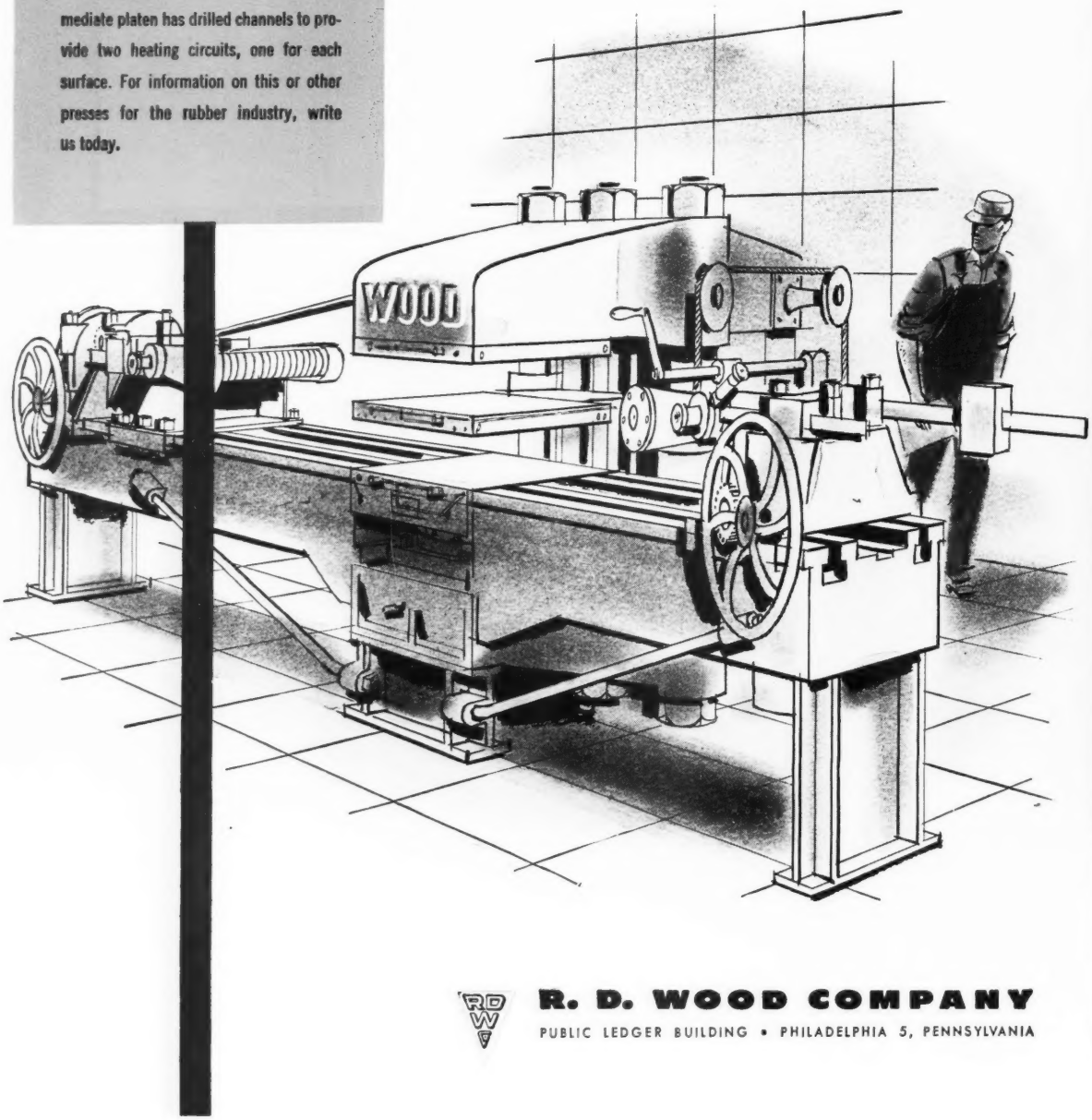


Open Gap 47-Ton Belt Press for curing flat and V-type transmission belts. The moving platen is accurately machined from a rolled steel slab and is guided by long, full-round babbitted guides on the strain rods. Intermediate platen has drilled channels to provide two heating circuits, one for each surface. For information on this or other presses for the rubber industry, write us today.

Prelude to low-cost production

When an R. D. Wood Press swings into action, gratifying things happen to production costs. For, in most cases, production climbs to a new high and downtime for repairs approaches zero. The reason is the smooth, dependable performance of R. D. Wood Presses—even under difficult conditions. And the reasons for this superior performance are the exacting standards set by R. D. Wood—in design, selection of materials, and craftsmanship. If your company's theme is low-cost production, here is your prelude—ready made.



R. D. WOOD COMPANY

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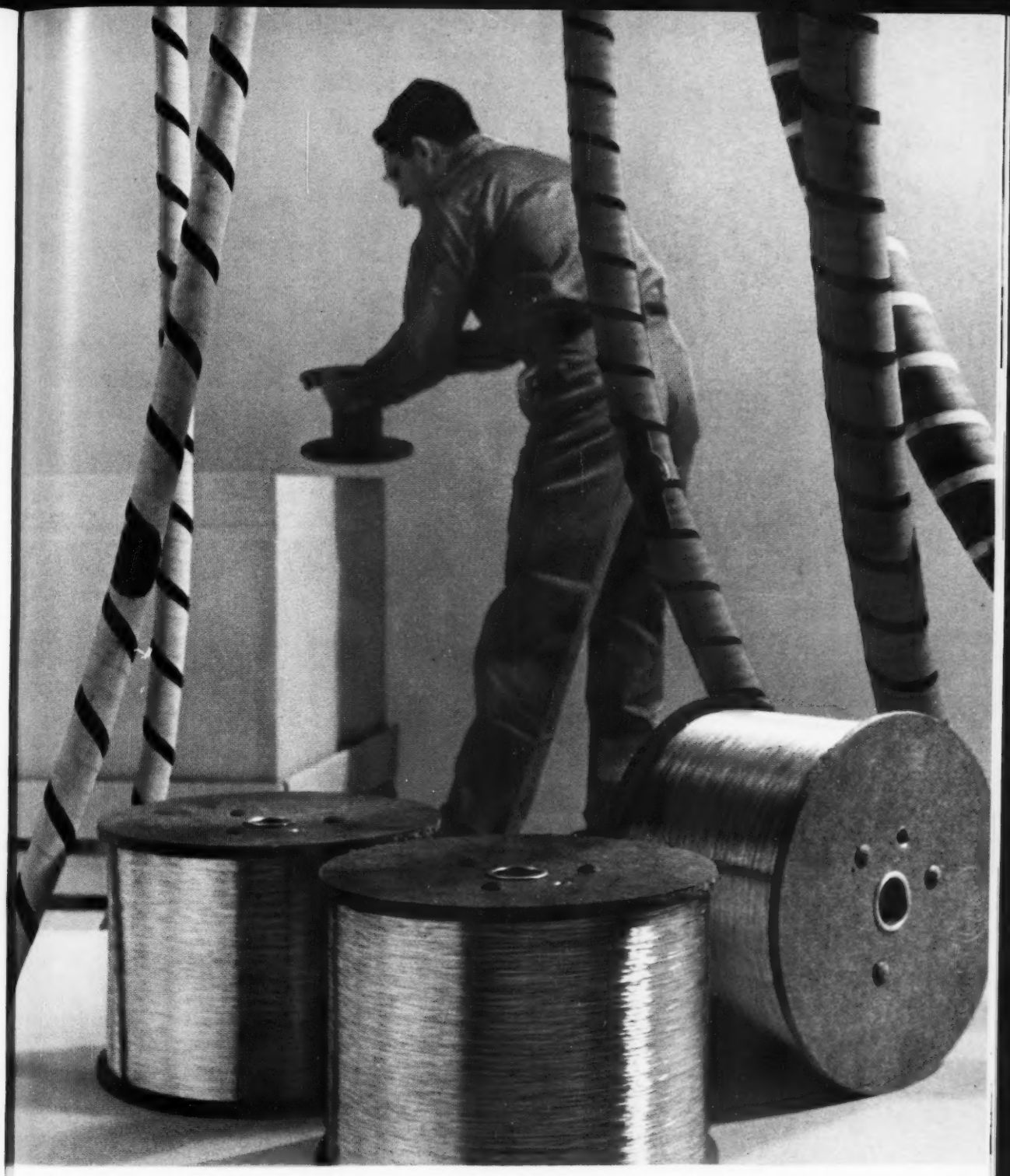

Roebling Hose Reinforcing Wire...

The best things come in no-charge packages

When you buy Roebling Hose Reinforcing Wire it is delivered to you on no-charge spools that mean savings to you.

This modern method of packaging does away completely with deposits and the bookkeeping involved; it contributes, too, to lower freight costs. Thus, you avail yourself of a precision-made and quality controlled product, without any handling, shipping and inventory inconveniences.

Roebling Hose Reinforcing Wire, used for braiding reinforcement, is produced in a complete range of sizes. Write Wire and Cold Rolled Steel Products Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

Roebling . . . Your Product is Better for it

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SEVEN LEAGUE BOOTS

for superior processing in your mixing operations

Marbon "8000-A"®

REINFORCING HIGH STYRENE RESIN

. . . the Durable Part of Durable Soles

- **FOR "ONE-STEP" MIXING OPERATIONS**
- **REDUCED COST**
- **INCREASED TOUGHNESS**
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Whether your problem is the uniform blow of expanded soles, maximum flex-life or resisting abrasion, there is nothing to compare with Marbon 8000-A. This superior-processing resin provides fast fusion at low mixing temperatures, reduced scorch, bright colors, rapid smooth-out . . . all at lower cost. For particular use with Neoprenes and natural rubber.

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MARBON . . . It BLENDS as STRENGTHENS as it IMPROVES

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NEVER HEARD OF IT!

. . . a good tan can be very becoming on a pretty girl — but can prove very objectionable in light colored rubber stocks —

NONOX

Non-Staining Anti-Oxidants

WSL (LIQUID)

A very powerful non-staining anti-oxidant for many types of natural and synthetic rubber compounds . . .

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An excellent non-staining anti-oxidant for polyethylene, also for a wide range of natural and synthetic rubber compounds . . .

THESE new non-staining anti-oxidants have been developed by Imperial Chemical Industries and are being introduced in the United States by their associates, Arnold, Hoffman & Company, Inc., Providence, R. I. and distributed to the rubber and plastics industry by Harwick Standard Chemical Co.

Write for complete data on the use of these products in various formula evaluations.

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BLOWING AGENT for producing a fine, closed cell, even-sized pore structure in natural and synthetic rubber compounds, P.V.C. and Polyethylene.

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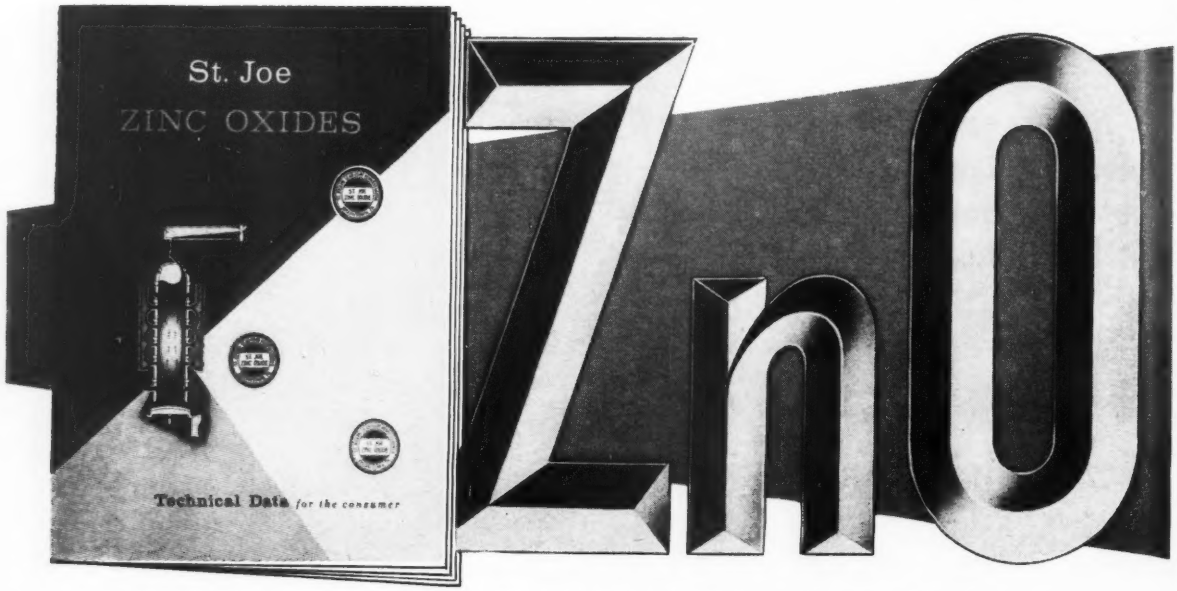

SECTION 1—*Production*

Preface • A Short History of the St. Joseph Lead Company • The Production of St. Joe Zinc Oxides • Mining • Milling • Roasting • Sintering • Electrothermic Smelting Process • Collecting and Packing • St. Joe Zinc Oxide Pellets • St. Joe Granular Zinc Oxide • Unit Loading of Zinc Oxide in Bags • Research and Development

SECTION 2—*Technical Data*

General Properties of Zinc Oxide • Zinc Oxide in Rubber Compounds • Tables—Fast Curing Types, Slow Curing Types, Surface Treated Types, Latex Grades • Zinc Oxide in Protective Coatings • Table—Paint Grades • Zinc Oxide in the Ceramic Industries • Table—Ceramic Grades • Zinc Oxide in Chemical, Pharmaceutical and other Industries • St. Joe Distributor Locations

ST. JOE ZINC OXIDES, a 48-page, 8½" x 11" illustrated booklet, is yours for the asking. In it we have included that information which is considered to be of maximum interest and value to the consuming industries. Because of our unique Electrothermic Process, an outline of the method by means of which we produce our lead-free, American Process zinc oxides, has also been included. As the table of contents indicates, the production aspects of ST. JOE ZINC OXIDES appear in Section 1 and supplements the technical data in Section 2 of this book.

Copies can be obtained free of charge by writing to:

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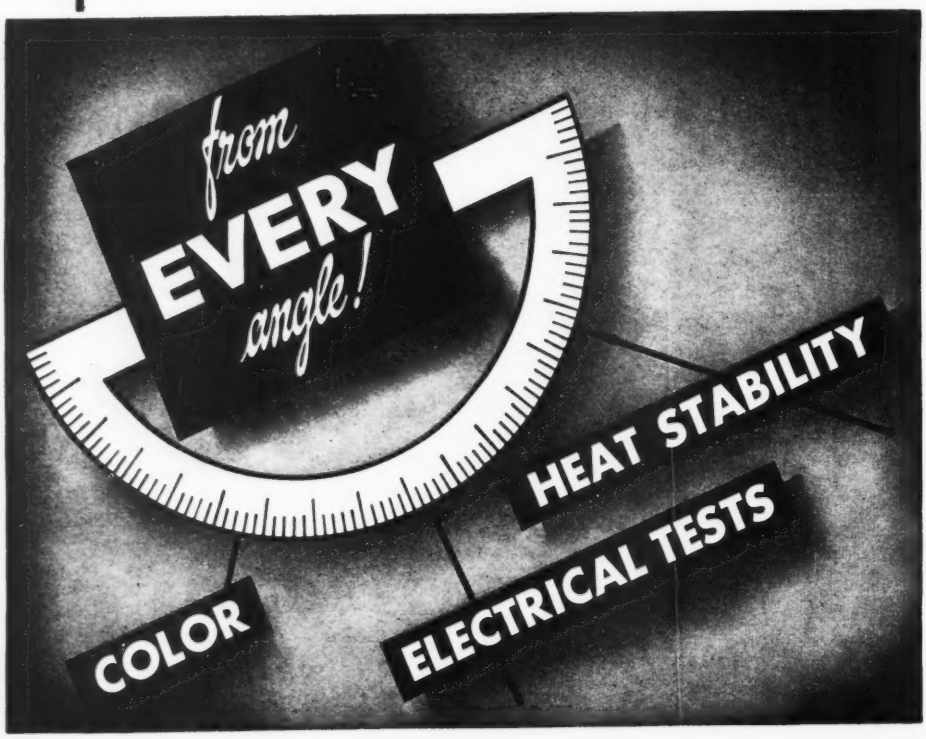

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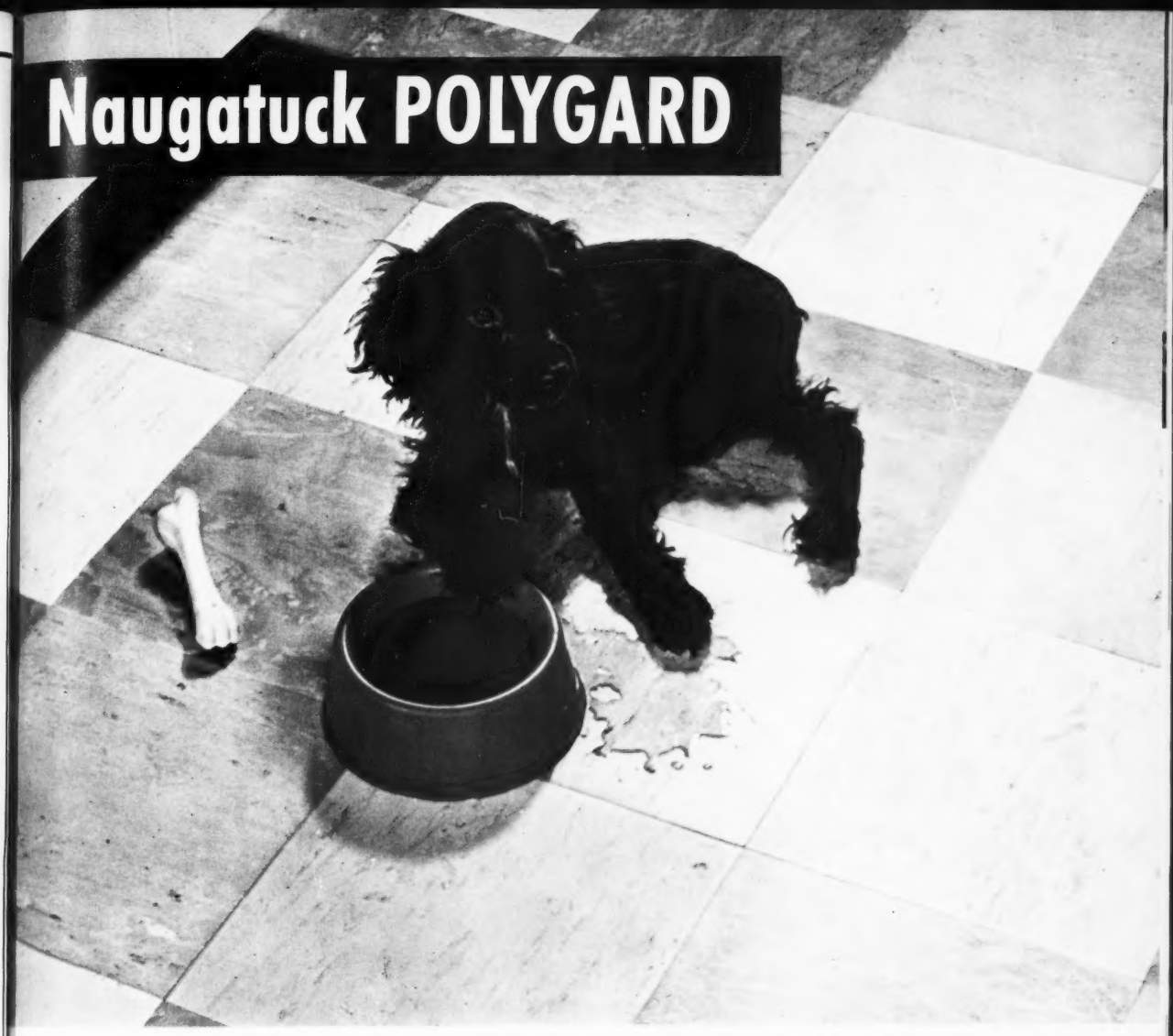
Naugatuck POLYGARD



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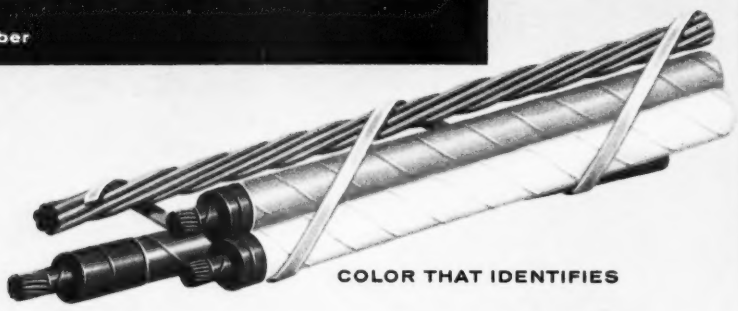
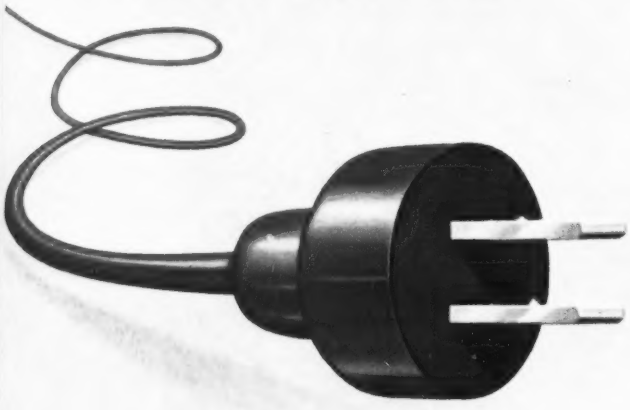


COLOR THAT IDENTIFIES

COLOR THAT ADDS EYE APPEAL



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Wire Patenting

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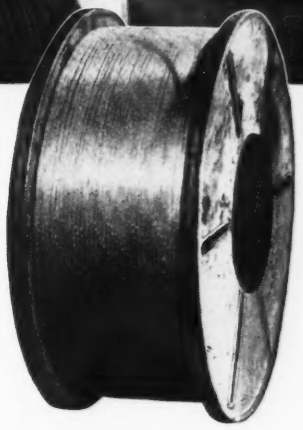

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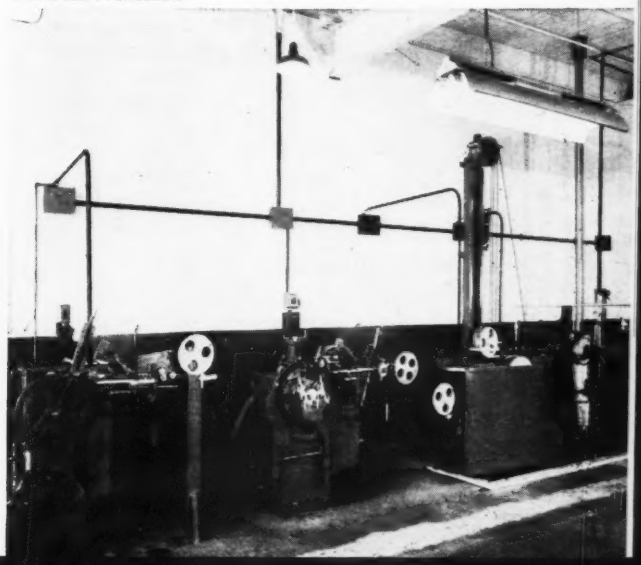

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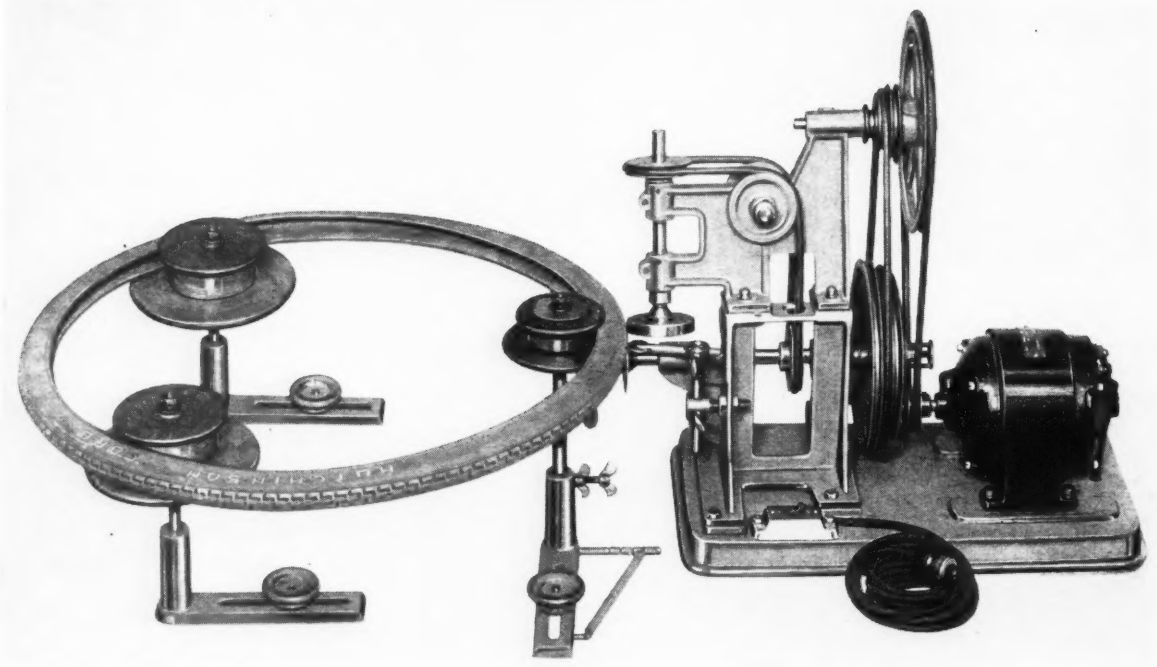

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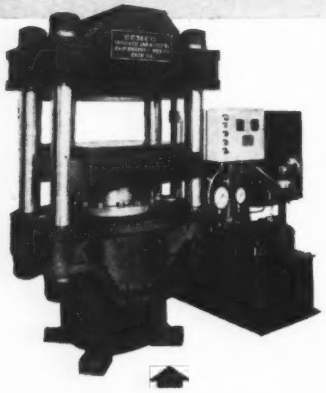

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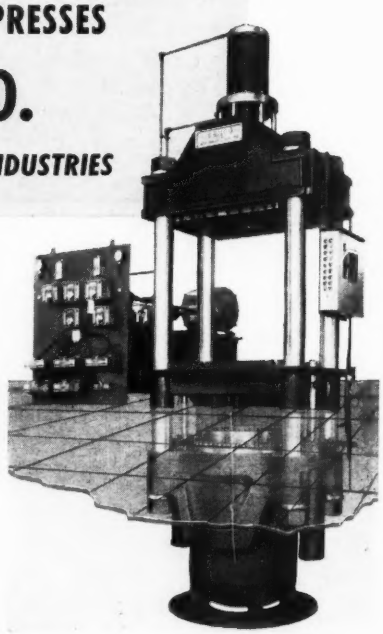

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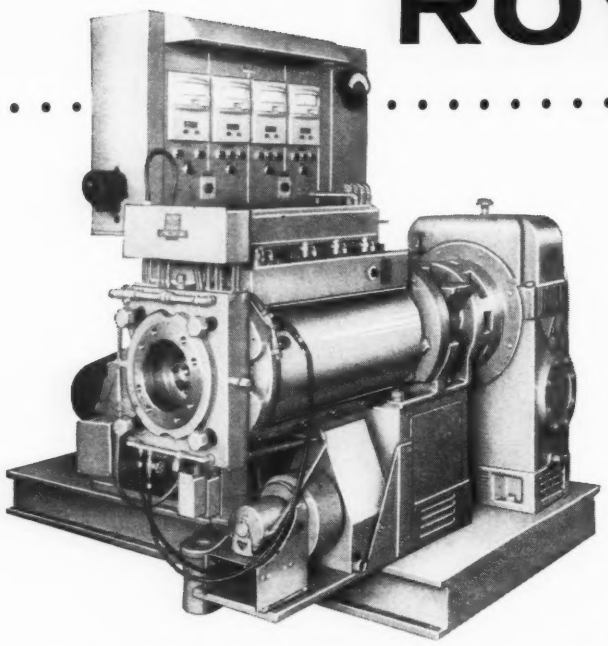

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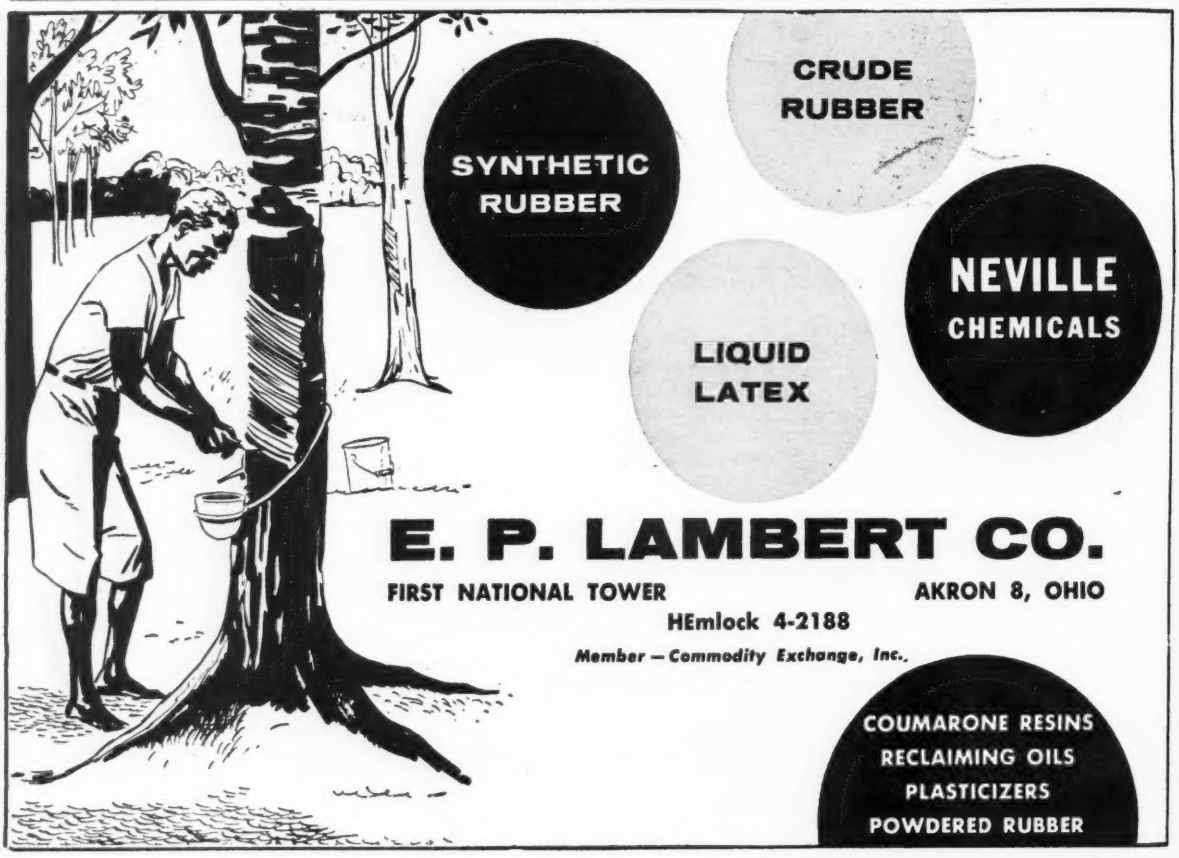

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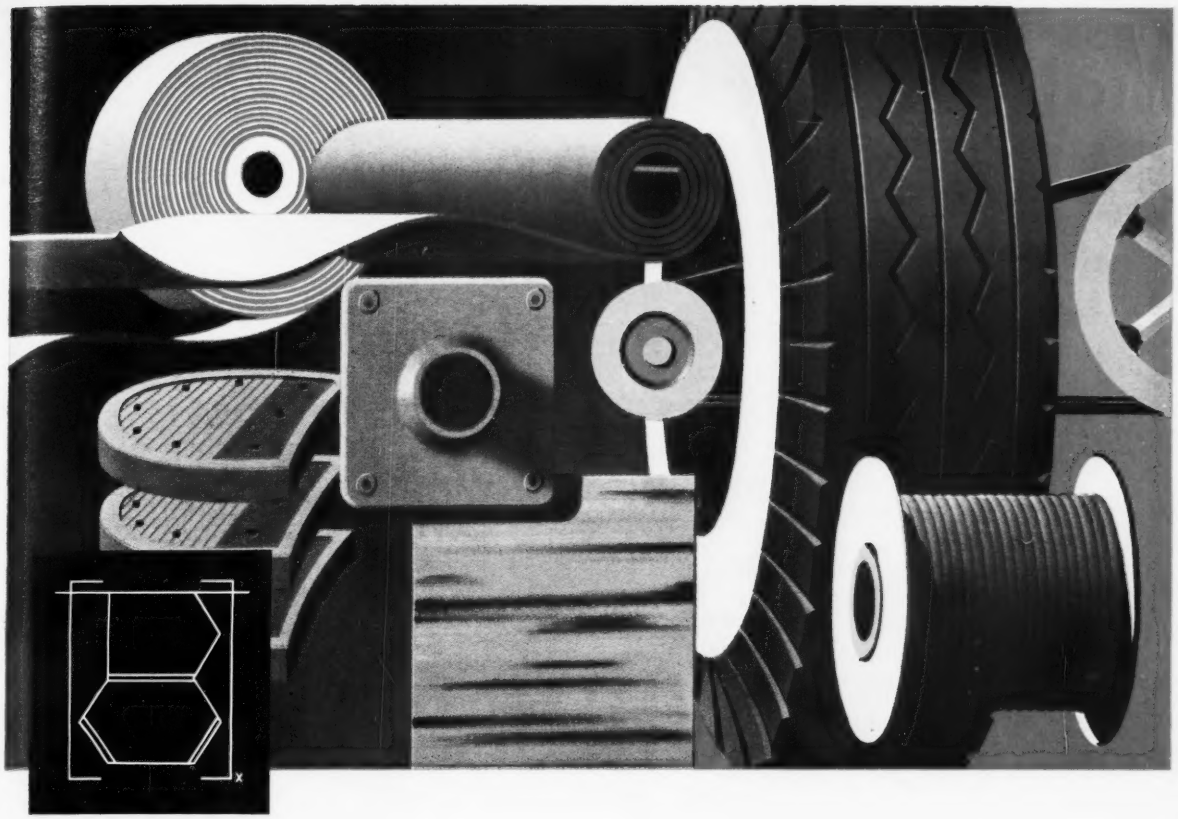

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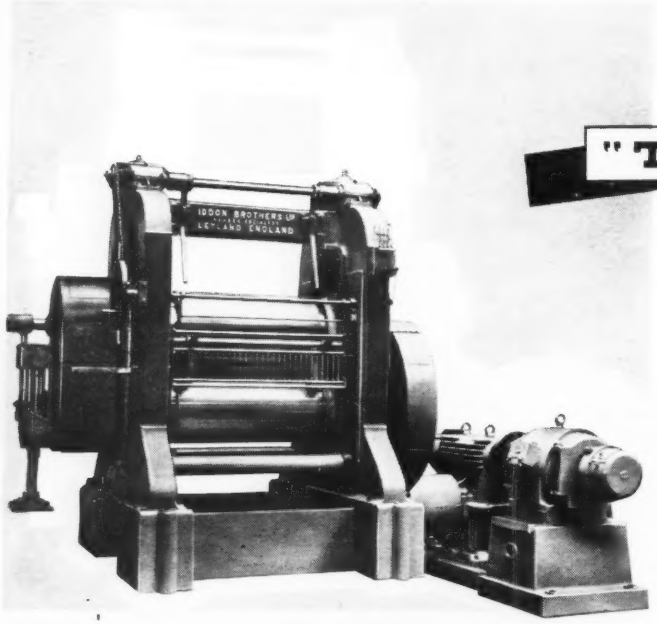

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Now—Lowest cost Polyurethane Foams

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The Hoover Commission recommends that the Government adopt "annual accrued expenditure budgeting." This sounds complicated but simply means that Congress would, in a given year, appropriate only for the goods and services the Government *purchased* in that year. This is the basis on which modern business – and most homes – are operated.

Last year the Senate expressed its approval of this modern budgeting practice (S.434) without a dissenting vote. The measure was approved by the House of Representatives Committee on Government Operations and by the House Rules Committee. Now only a House floor vote on H.R. 8002 is needed for its adoption.

Where you get into the act

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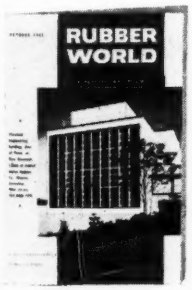

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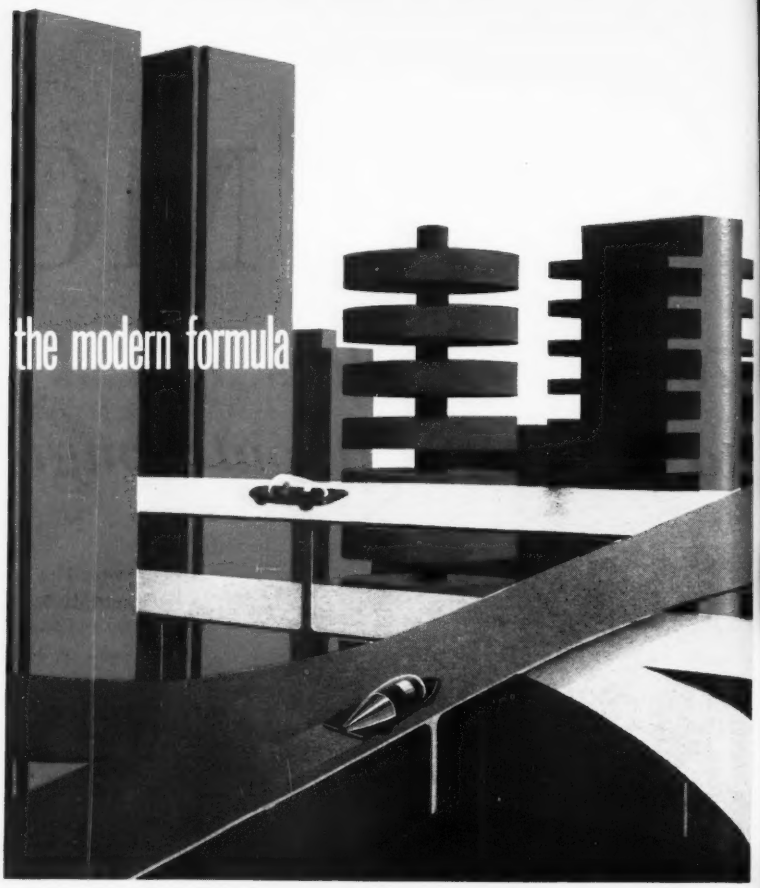

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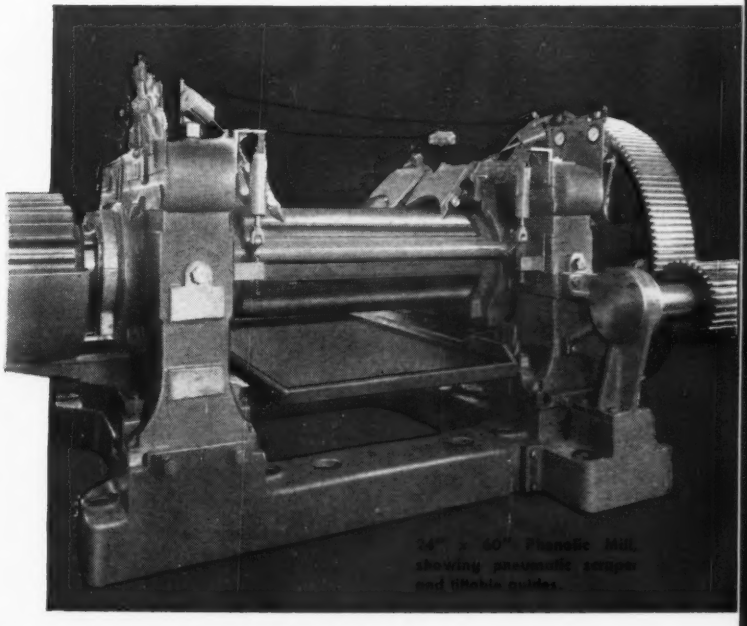

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RUBBER WORLD
EDITORIAL

1958 Census Should Report On Both Rubber and Plastics

THE Bureau of Census of the Department of Commerce has been reviewing in recent months the commodity inquiries included in the 1954 Census of Manufactures forms to determine how they should be adapted to use in the 1958 census. Proposed product inquiries have been circulated to representative groups in industry and government to find out if these census forms reflect the needs of those who report or use the statistics.

We have discussed this matter of rubber industry statistics and government Standard Industrial Classifications in this column on two previous occasions: namely, December, 1956, and February, 1957. In February, 1957, we called attention to the fact that the proposed new S.I.C. 30—"Rubber and Miscellaneous Plastics Products," might be an overly ambitious project in that it would be an attempt to collect statistics from both the rubber and plastics industries on the same form, and, as such, it might not be particularly helpful to either industry.

The proposed product section for form MC-30A, now called "Rubber and Related Products," for the 1958 census is now considered quite worthwhile, *if all the data are actually collected and reported as planned.*

For example, along with data on "Rubber Footwear," there is provision for collecting figures on "Plastic Arctics and Gaiters"; in addition to data on "Rubber Mechanical Goods," there are provisions for collecting figures on "Plastic Mechanical Goods," in this instance floor and wall coverings; under "Hard Rubber and Plastic Mechanical Goods," data would be collected on both hard rubber and plastic battery boxes; and under "Industrial Mechanical Goods," figures would be obtained not only for molded rubber products, but also for various types of molded plastics products, and similarly data would be recorded for extrusion and lathe-cut products made from rubber and from plastics.

"Sponge Rubber Products" will include latex foam and chemically blown sponge rubber. Another category, "Expanded (Foamed) Plastics," is set up presumably to include vinyl, polyethylene, and urethane foams and is too much of an over-simplification. Urethane foam is comparable with latex foam in physical properties for many uses. One consumption estimate suggests that there will be 128 million pounds of urethane foam used in 1960 and 327 million pounds in 1965, as compared with 297 and 256 million pounds of latex foam in 1960 and 1965, respectively. Individual statistics for urethane, vinyl, and latex rubber foams should be obtained. Also, there is an urgent need to determine whether urethane foam should be classed as rubber or plastic.

The Census Bureau should be encouraged to collect and report data in the 1958 census on both rubber and plastics products made by rubber industry companies; it will present a truer picture of today's rubber industry.

R. G. Seaman

EDITOR

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RUBBER WORLD

Mooney Viscosity as Related To Molded Electrical Products[1]

By A. A. KESSEL
General Electric Co., West Lynn, Mass.

Rubber technologists are continually on the lookout for means of taking rubber processing out of the "trial and error" category. This paper shows how some of the original work done by M. Mooney in connection with the development of the Mooney viscometer for measuring the plasticity of rubber was used as a starting point to develop a method for determining optimum fill rate and molding temperature for injection molding of electrical apparatus with elastomeric materials.

By using Mooney's original derivations and data obtained on stocks of compounded butyl rubber, equations and curves were developed for the relations among stock temperature, Mooney viscosity, the rate of fill, and the force applied to the insert during the molding process. The curves were then combined into a chart of Mooney gage reading *versus* fill rate and temperature for molding an electrical transformer at a predetermined force on the primary coil.

PREVIOUS work by M. Mooney[2] has shown that the Mooney viscometer gives a measurement of plasticity or viscosity of an unvulcanized rubber. Plasticity is determined by measuring the drag on a rotating surface resulting from the resistance of the rubber in contact with it to shearing action. The Mooney data are normally used for quality-control testing and the evaluation of new compounds to see if they will conform to established specifications. This paper discusses a method of correlating the Mooney data with the parameters of injection molding.

Although recent studies [3,4,5] have indicated that turbulent, complex flow patterns frequently occur in

[1] Presented before the Division of Rubber Chemistry, ACS, New York, N. Y., Sept. 12, 1957.
[2] M. Mooney, *Ind. Eng. Chem.* (*Anal. Ed.*), 6, 2, 147 (1934).

The Author

A. A. Kessel, technical engineer, instrument department, General Electric Co., received his B.S. degree in chemical engineering from Purdue University in 1942.

Mr. Kessel has been employed by General Electric since 1951 as a technical engineer. He is a co-inventor of "HyBute 60" non-tracking butyl rubber insulation, announced by G-E a year or two ago.

He is also a member of the American Chemical Society and of the Division of Engineering & Industrial Research of the National Research Council.

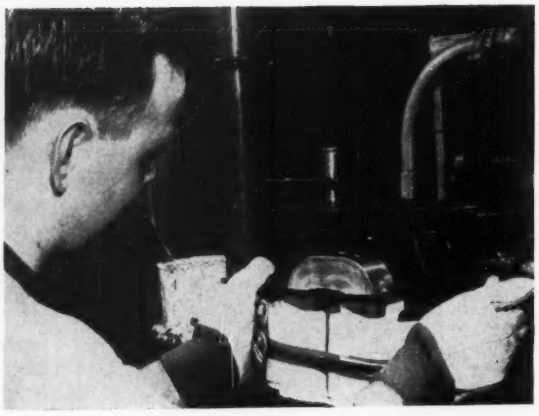


Fig. 1. Loading transformed insert into mold

Fig. 2. Removing vulcanized transformer from the mold

the Mooney viscometer, the assumption of a relatively simple dependence of viscosity on rate of shear has appeared to be adequate for giving useful results in the present work.

In the injection molding of electrical apparatus with elastomeric materials, the components are positioned within a mold, Figure 1, and the elastomer is then forced into the mold cavity from the bottom and vulcanized, Figure 2. It is essential that the force of the material on the parts during the fill operation be controlled to prevent displacement and thus insure adequate thicknesses of insulation between the components.

Using M. Mooney's original derivations and the author's data obtained on stocks of mineral-loaded butyl rubber, equations and curves have been developed showing the relations among the rate of fill, stock temperature, Mooney plasticity, and the force applied to the insert during the molding process. The curves were then combined on one chart at an experimentally determined critical force. By simply determining the Mooney plasticity of an unknown stock, the optimum fill rate and the temperature can be obtained from the chart.

Experimental Work

Four batches of unaccelerated mineral-loaded butyl rubber were prepared having standard Mooney plasticity values of 21, 36, 51, and 75, designated A, B, C, and D respectively, measured at 121° C (250° F.) with the large rotor. All readings were recorded after 10 minutes as the gage reading was constant at that time. Enjay Butyl 035[6] was used, and each plasticity was obtained by varying plasticizers and fillers.

A preliminary test was made with the stock having a Mooney plasticity of 36 to study the relative increase in temperature of the sample when subjected to shearing rates higher than normally used. The temperature of the viscometer was set at 100° C, and the temperature was measured by means of a thermocouple in the rubber, with the results shown in Table 1.

[3] D. S. Fenson, *Can. J. Technol.*, 33, 194 (1955).
[4] D. Craig, A. E. Juve, *et al.*, RUBBER WORLD, 136, 75 (1957), abstract only.
[5] Baader, *Kautschuk u. Gummi*, 7, WT 263 (1954); *Rubber Chem. Tech.*, 28, 588 (1955).
[6] Enjay Co., Inc., New York, N. Y.

TABLE 1. EFFECT OF HIGHER MOONEY VISCOMETER SHEAR RATES

Motor Speed, Rpm.	Rotor Speed, Radians/Sec.*	Thermocouple Temp. °C. (after 15-Min. Run)
0	0	99
1300	0.153	99.75
1700 normal speed	0.203	100.5
2400	0.298	101

* To convert to rpm. multiply by 9.55.

TABLE 2. MOONEY VISCOSITY AT VARIOUS SHEAR RATES AND TEMPERATURES

Sample	Temperature, °C.	Rotor Speed, Radians/Sec.	Mooney Plasticity, G (ML-10)
A	80	0.225	39.25
		0.175	36.25
		0.126	32.50
		0.085	27.50
		0.047	22.00
		0.026	17.50
A	100	0.217	28
		0.170	23.5
		0.127	22
		0.086	19.25
		0.046	14.75
		0.026	11
A	120	0.225	20.5
		0.168	18
		0.113	15.25
		0.079	13
		0.046	10.5
		0.026	8.5
A	140	0.221	17
		0.175	15
		0.125	13
		0.079	10.5
		0.046	8.5
		0.026	6

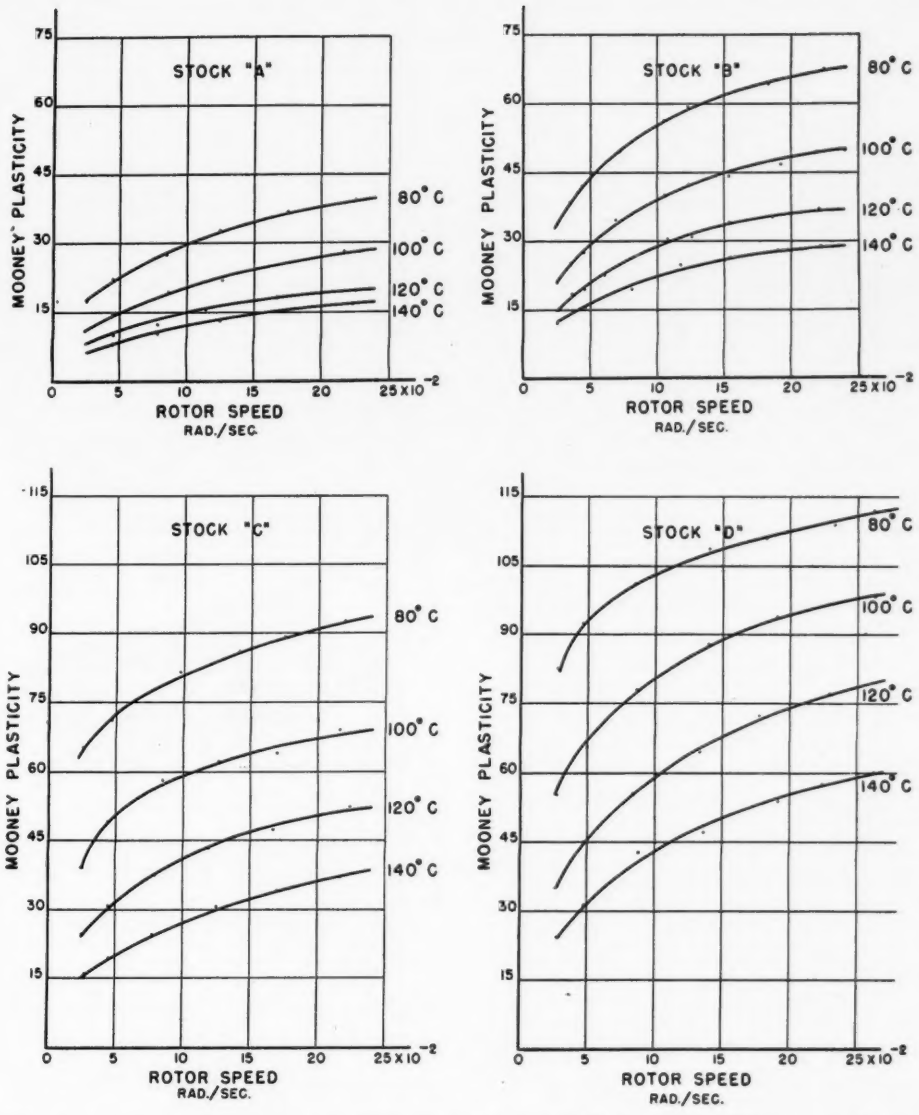


Fig. 3. Mooney viscosity *versus* shear rate (rotor speed) for four different stocks at four different temperatures

Thus the effect of shear rate was negligible since the temperature is controlled only to ± 1° C.

The Mooney plasticity, G, for each of the four stocks was measured with varying rotor speeds at each of four temperatures: 80, 100, 120, and 140° C. The results presented in Table 2 for the A stock are typical of the experimental data obtained; while the complete data for all four stocks are plotted on Figure 3.

Analysis of Results

VISCOSITY VS. SHEAR RATE. Work by M. Mooney has shown that the torque developed on the rotating shaft of the viscometer gives a measure of the viscosity of rubber.[2]

$$\text{Torque} = (\text{mean viscosity}) \times (\text{rate of shear}) \times (\text{moment arm}) \times (\text{area}) \quad (1)$$

The true mean viscosity is also proportional to the gage reading. The factor of proportionality, k, between the torque and gage reading, G, is dependent on the details of the viscometer such as the spring constant and the gear pitch.

$$\text{Torque} = kG \quad (2)$$

The gage reading, which is also the Mooney plasticity, can then be expressed in terms of the mean viscosity, rate of shear, and a Mooney factor F_M, based on the dimensions and details of the viscometer.

$$G = (\text{mean viscosity}) \times (\text{rate of shear}) \times F_M \quad (3)$$

In the general equation for a non-Newtonian material, the mean viscosity of rubber is proportional to

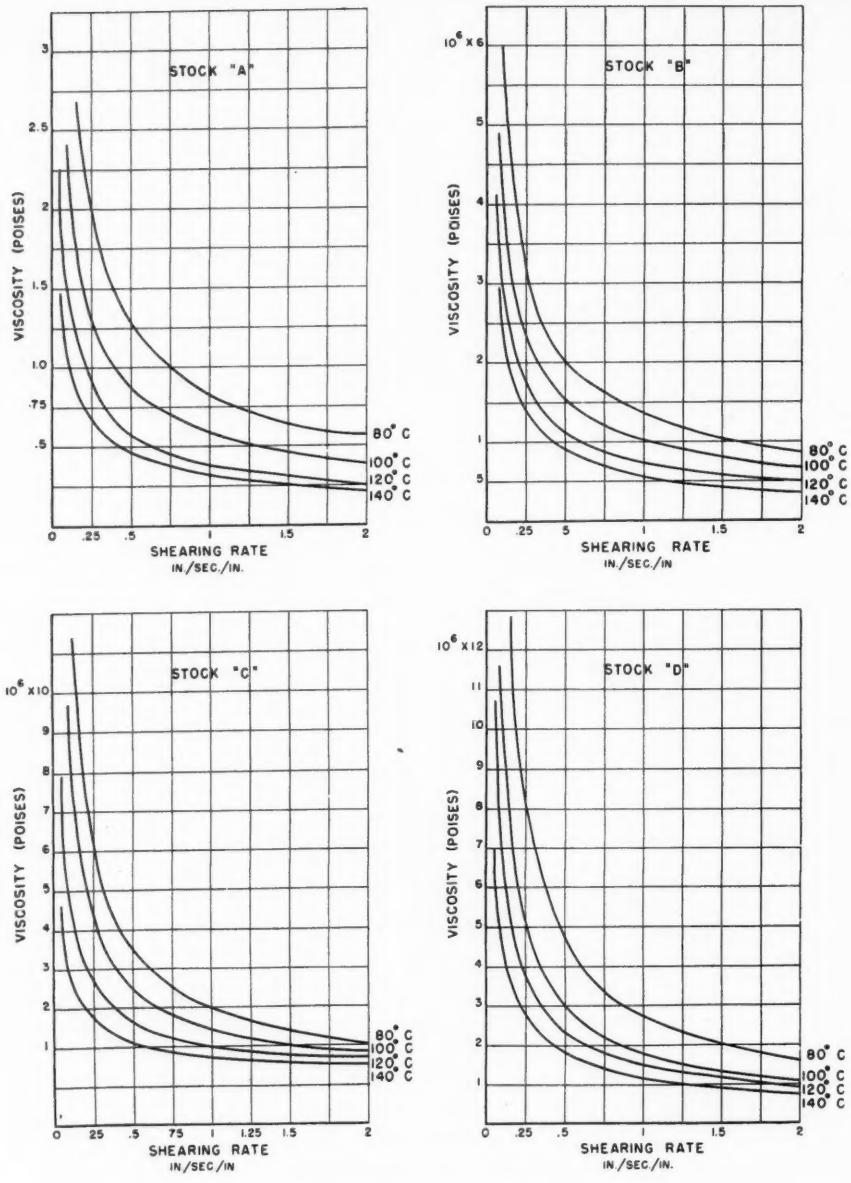


Fig. 4. Viscosity *versus* linear shear rate for four stocks at four different temperatures

a constant, a, times some power of the linear rate of shear.

$$\text{Mean viscosity} = a \times (\text{linear rate of shear})^{b} \quad (4)$$

Combining these equations, we can then set up an expression for the gage reading in terms of the angular velocity of the rotor Ω.

$$G = K\,\Omega^{b+1} \quad (5)$$

Substituting two sets of values at 80° C. from Table 2 into equation 5;

$$22 = K\,(.047)^{b+1}$$
$$36.25 = K\,(.175)^{b+1}$$

we can solve simultaneously for b and K

$$b = -.622$$
$$K = 70$$

Therefore the equation for the gage reading at 80° C., in terms of the angular velocity of the rotor (or rotor speed in rad./sec.) is:

$$G = 70\,\Omega^{.378}$$

Using the Mooney plasticity or viscosity values measured at the other temperatures, we can thus establish calculated equations from Table 2 for each material at each temperature. Since the same results are obtained for the constants b and K with any two sets

TABLE 3. MOONEY VISCOMETER GAGE READING IN TERMS OF ANGULAR VELOCITY OF ROTOR

Sample	Temperature, °C.	Gage Reading, G
A	80	$70\Omega^{0.378}$
	100	$53\Omega^{0.424}$
	120	$37\Omega^{0.412}$
	140	$35\Omega^{0.500}$
B	80	$113\Omega^{0.324}$
	100	$91\Omega^{0.386}$
	120	$70\Omega^{0.408}$
	140	$54\Omega^{0.386}$
C	80	$120\Omega^{0.169}$
	100	$94\Omega^{0.212}$
	120	$87\Omega^{0.339}$
	140	$69\Omega^{0.405}$
D	80	$176\Omega^{0.212}$
	100	$141\Omega^{0.249}$
	120	$131\Omega^{0.358}$
	140	$107\Omega^{0.410}$

TABLE 4. MEAN VISCOSITY AS FUNCTION OF LINEAR RATE OF SHEAR

Sample	Temperature, °C.	Mean Viscosity
A	80	$0.823 \times 10^6\ S^{-0.622}$
	100	$0.575 \times 10^6\ S^{-0.576}$
	120	$0.390 \times 10^6\ S^{-0.588}$
	140	$0.324 \times 10^6\ S^{-0.50}$
B	80	$1.39 \times 10^6\ S^{-0.676}$
	100	$1.01 \times 10^6\ S^{-0.614}$
	120	$0.75 \times 10^6\ S^{-0.600}$
	140	$0.59 \times 10^6\ S^{-0.614}$
C	80	$1.98 \times 10^6\ S^{-0.830}$
	100	$1.45 \times 10^6\ S^{-0.788}$
	120	$1.05 \times 10^6\ S^{-0.661}$
	140	$0.73 \times 10^6\ S^{-0.595}$
D	80	$2.71 \times 10^6\ S^{-0.787}$
	100	$1.82 \times 10^6\ S^{-0.751}$
	120	$1.58 \times 10^6\ S^{-0.842}$
	140	$1.20 \times 10^6\ S^{-0.590}$

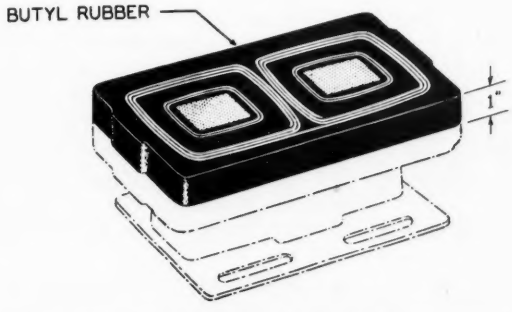


Fig. 5. Cross-sectional view of molded transformer showing rubber involved

of values within each group, these equations (Table 3) fit the experimental curves, as shown in Figure 3, without much deviation.

Substituting numerical values of G from Table 3 into equation 3, we can then develop equations for the mean viscosity as a function of the linear rate of shear, s, at each temperature (Table 4) shown graphically in Figure 4.

As the viscosity and linear shear relation in the Mooney viscometer is the same as in the actual molding operation, we can now correlate Mooney values with production equipment.

FORCES IN THE MOLD. The definition of viscosity states that when a material of a certain viscosity is forced between two plates at a speed of v, a drag will be produced on one plate of F lbs./in^2.

$$F = \frac{\text{viscosity} \times \text{speed} \times \text{area}}{\text{thickness}} \qquad (6)$$

Using this equation, the viscosity-shear rate curves in Figure 4, and the dimensions of the mold and the insert for a 5,000-volt current transformer now in production, we have calculated the force on the primary coil during the filling operation. The dimensions of this-type transformer involved in the calculations are:

cross-sectional area of rubber = 16.1 in.^{2}
average thickness of rubber = 0.31 in.
surface area of primary coil = 173 in.^{2}

The following procedure was used to calculate the force in the mold for a specific fill rate of one lb./min.

The cross-sectional area of rubber, Figure 5, from the original dimensions of the components, is 16.1 in^2. Therefore the volume of one inch of height is 16.1 x 1 or 16.1 in.^{3}

The weight of 1.55 specific gravity rubber for this volume is:

$$16.1 \text{ in.}^3 \times \frac{62.4 \text{ lbs.}}{1728 \text{ in.}^3} \times 1.55 = 0.9 \text{ lb.}$$

This can also be written as 1.1 inches of height per pound of rubber.

The average linear shear rate is then calculated for a one lb./min. fill rate and average rubber thickness of 0.31-inch.

$$\frac{1.1 \text{ in.}}{\frac{0.31 \text{ in.} \times 60 \text{ sec.}}{2}} = 0.12 \text{ in./sec./in.}$$

Therefore, when the fill rate is one lb./min., the linear shear rate is 0.12 in./sec./in., and the speed, V, is 1.1 in./min.

Referring to Figure 4, the viscosity can now be determined for a shear rate of 0.12/in./sec./in. and substituted in equation 6 to determine the force.

Varying the fill rate for each stock and temperature a family of curves was developed Figure 6.

CRITICAL FORCE. High-voltage apparatus must have minimum thicknesses of insulation to prevent dielectric breakdown or ionization between the components. It

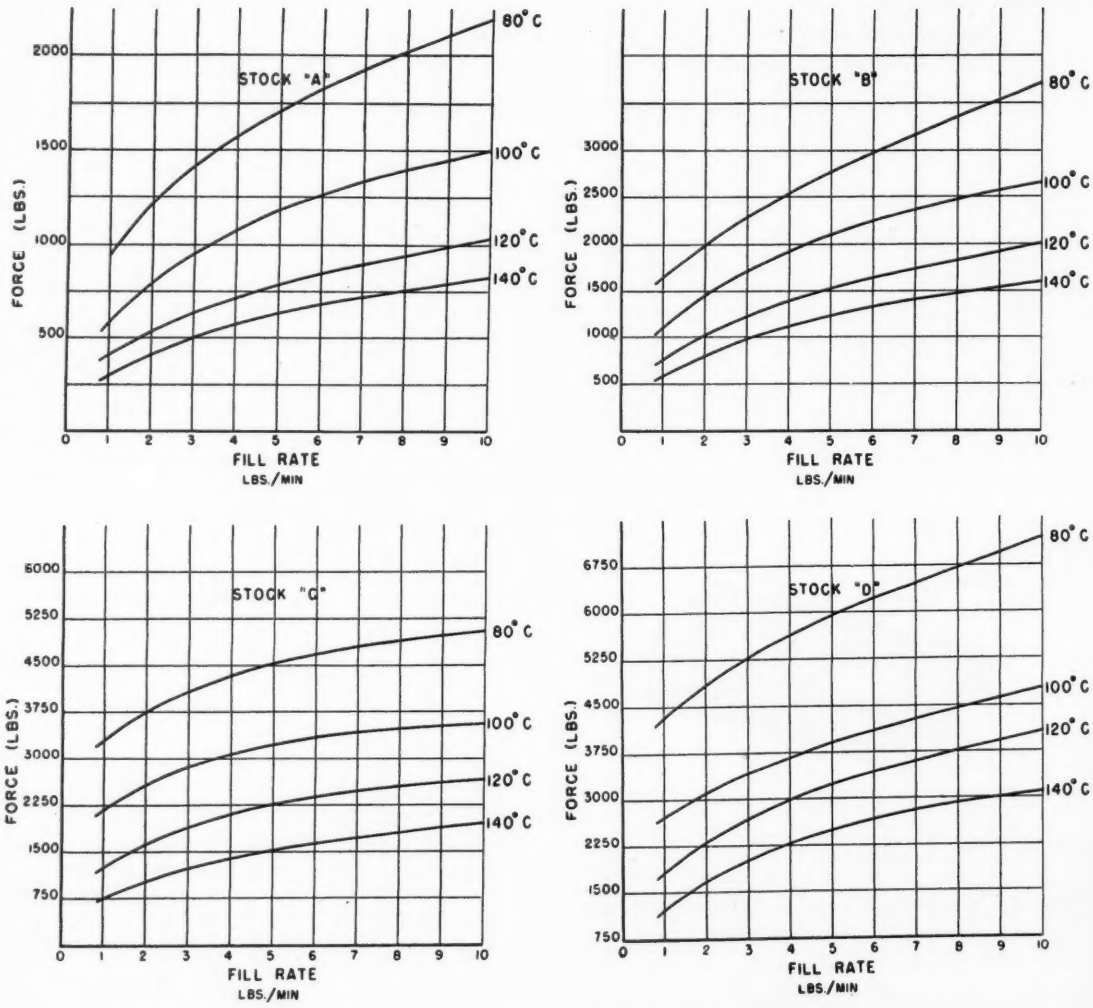


Fig. 6. Force on primary coil *versus* fill rate of mold for stocks at four different temperatures

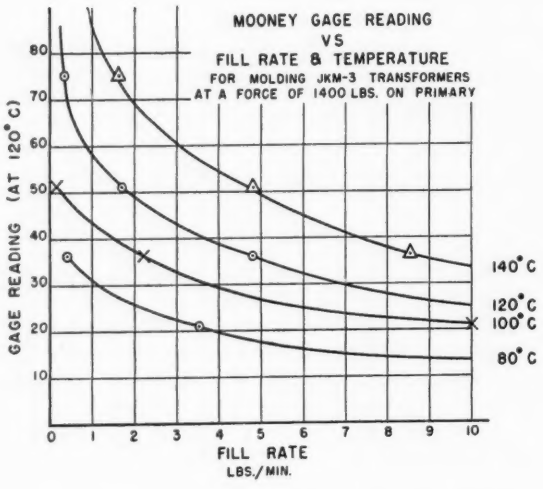


Fig. 7. Chart for selecting optimum values of fill rate and temperature with stocks of varying plasticity

is therefore, essential that the forces during molding do not disturb the positioning of components.

The critical force is the minimum force that will produce distortion of the insert as measured by electrical tests. To determine the critical force for the JKW-3 type of transformer, several moldings were made at 100° C. with the B stock at increasing rates of fill. The fill rates of the rejected samples were transposed to Figure 6, and the critical force was found to be 1,400 pounds. The groups of curves on Figure 6 were then combined on a chart (Figure 7) at a constant force of 1,400 pounds showing the extrusion rate as a function of Mooney gage reading and temperature.

Application

The practical application of this study is Figure 7, which shows how to select the optimum values of fill rate and temperature with stocks of varying Mooney plasticity and still stay below the critical force. The

(*Continued on page 710*)

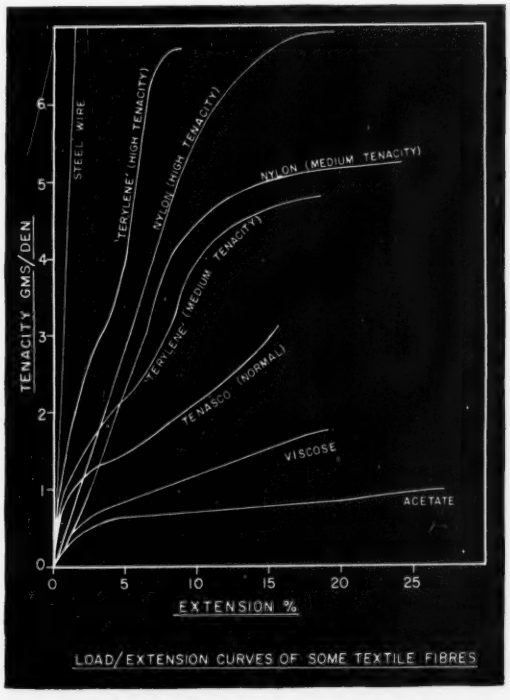
New Single-End Cord Treater—The Computreater

IT IS a maxim in this industrial age that though products continually improve, processing never gets any simpler. The maxim is occasionally overlooked, as in the case—a decade ago—of the jet engine, which was expected to be a great deal simpler and cheaper to build than the conventional reciprocating aircraft engine!

The maxim loses no strength when applied to cord impregnating processing as practiced in the rubber tire, V-belt, conveyor belt, and braided hose fields.

Over recent years the introduction of entirely new man-made fibers into cord construction (Figure 1) has opened new concepts of strength and service in the fabric and rubber assembly. Rayon, nylon, "Terylene,"[1] Dacron,[2] Perlon[3]—along with a parade of variant types in each classification—offer reinforcing properties to the finished assembly which were unthought of 20 short years ago.

All of these synthetic high polymers, however, pose individual handling problems which were likewise unknown in cotton-rubber systems. Sensitivity to process tensions . . . the necessity of careful application of heat and cooling for improved molecular orientation or crystalline structure refinement . . . requisite presaturation of hydrophobic fibers . . . additional stretching or shrinking process steps . . . advanced adhesive chemistry . . . all of these new factors—and more—dictate a multi-stage treatment of substantial complexity to produce optimum tensile strength and elongation in the treated cord.



LOAD/EXTENSION CURVES OF SOME TEXTILE FIBRES

Fig. 1. Load-extension curves on some of the synthetic fibers available for reinforcing rubber assemblies

To devise a successful treatment process to impregnate and prepare cord of top characteristics has, in fact, become a formidable job. The whole subject is one which is too "young" and fast-moving for the discovery of many basic formulae. General rules for the dimensioning of the many variables of time, temperature, tension, and chemistry do not exist, nor are the interactions between all variables thoroughly understood.

The only direct approach possible is an empirical one, in which various process sequences and values are actually tested out in practice. Unfortunately, it is not usually economically practical or physically feasible to carry out such experimentation on standard production equipment. The full-width tire cord impregnating line, for example, runs 2,000 ends of cord through a process sequence which, though it may involve 80 or 90 points of adjustment variation, is relatively fixed in purpose. The awaiting of a short period of production down time in order to run a single hurried test within a limited range of reference is a frustrating if not uncommon experience.

At the same time such pilot or laboratory equipment as is generally in use has neither the range of application nor the sensitivity of adjustment vital to the new process demands.

To meet the urgent need of a practical laboratory tool capable of speedy and precise process determinations, C. A. Litzler Co., Inc., of Cleveland, has introduced a new single-end laboratory cord treater specifically designed to solve today's formulation problems.

The new unit had its origin in broad Litzler experience in the design of full-width fabric lines, as well as in specific exploration with both fiber and rubber companies to set exploratory operating conditions of sufficient latitude to serve the user of the machine for a long time into the future.

Pilot-Unit Development Concepts

Development of the pilot unit was further based on four significant concepts.

[1] Polyester fiber based on terephthalic acid, Imperial Chemical Industries, Ltd., London, England.
[2] Polyester fiber from methyl terephthalate and ethylene glycol, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
[3] Isocyanate polymer fiber, Farbenfabriken Bayer, A.G., Leverkusen, Germany.

New Single-End Cord Treater—the Computreater

To meet the need of a practical laboratory tool capable of speedy and precise process determinations in the field of cord impregnation as practiced in the rubber industry, C. A. Litzler Co., Inc., Cleveland, O., has developed a single-end laboratory cord treater or pilot unit called the Computreater.

This new unit is a scaled-down version of the most modern production installations; it is provided with sensitive control instrumentation, is readily adaptable to any scheme of treatment presently foreseeable, and was designed on the single-end basis of operation since precision processing of a single cord offers exceptional speed and economy in obtaining test results.

The several fields of investigation now being planned with the units now delivered to industry include a thorough study of heating, impregnation, stretching, and final orientation of a particular fiber; research on drying tensions and tension rate applications in relation to ultimate elongations of the various cord assemblies; investigations of pick-up and absorption rates; study of the fatigue value of cords impregnated with solutions of varying characteristics in relation to drying tensions, etc. It is expected that the results of some of these investigations can be presented at a later date.

Other uses being considered for the Computreater are installation of a unit to operate in parallel with a full-width production machine as a means of continuous supervision of quality control, and utilization of a Computreater as an essential element in automated production by transfer of the pilot-unit process data to a punch-card system. The Computreater punch-card would then be inserted into a card reader, which would feed in turn the data to an automatic control unit that would make all line adjustments on a full-scale production unit.

The first of these is that the equipment could by no means be of "toy" caliber, but must, on the contrary, be a thoughtfully scaled-down version of the most modern production treating machinery. Built to the best production standards, it is capable of high-stability operation which is vital to prompt arrival at precise test results.

The second important consideration is the provision for sensitive instrumentation and extensive control so that processing may be precisely evaluated and optimum conditions pinpointed. While the degree of instrumentation is at the option of the user in accordance with his needs, whatever values and readings are produced are in any case directly translatable to full-scale equipment without interpolation or adjustment.

Third factor in the new unit's design is its wide scope of operation. Individual line units (which may be operated in any desired sequence or bypass of process steps) are designed to reproduce every degree of processing of possible usefulness to industry. The equipment is readily adaptable to any scheme of treatment presently forseeable, with extremely broad ranges of heating, cooling, orientation, stretching, and heat shrinking, with or without single or double dipping or surface coating. Conditions of constant tension or constant stretch can be maintained on a zonal basis.

The fourth design consideration is the unit's single-end basis of operation. Precision processing of a single cord offers exceptional speed and economy in test results. A pound of material is more than enough to evaluate thoroughly the most complex impregnation process. A single technician can set up a process and produce samples for decisive testing, under conditions immediately reproducible on full-width production equipment, in a few hours. Equipped with its accessory tire fabric building drum, the unit will produce sufficient ply for construction of four actual experimental tires in a single day's operation.

Computreater Process Line

The new Litzler laboratory pilot unit (as shown in Figure 2) has been given the name Computreater in analogy to the electronic digital computer. Each of these machines, Computreater and computer, have been designed to provide speedy, accurate answers to complex problems involving many variables; a further resemblance is noted in the Computreater's capacity for rapid production of small-volume, but homogeneous samples with perfect reproducibility on full-scale equipment, making it possible to pursue impregnation process development on a statistical basis involving step changes of significant conditions.

While the Computreater is a system of flexible units which may be selected and installed in any desired combination and arrangement to meet particular needs, Figure 3 illustrates a typical arrangement of equipment for a very high degree of tire cord treatment. As can be seen, the line consists of the following components in the direction of cord travel:

(1) THE LET-OFF SECTION. This section provides two ball-bearing-mounted friction spindles for carrying cord spools. From the let-off spool the cord proceeds through further pretensioning devices, over a manually loaded dancer roll, and finally into the presaturation tank. The presaturation tank is arranged for variable

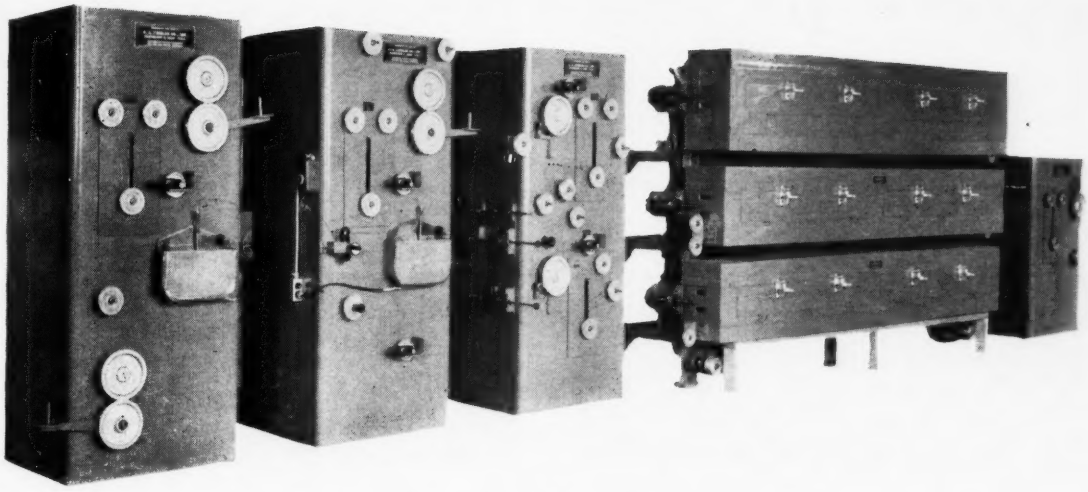


Fig. 2. A typical single-end Computreater process line

times of immersion of the cord beneath the surface of the solutions contained therein. Multiple-wrap immersion sheaves and several threading paths allow a wide latitude in the immersion time at any basic cord speed.

After impregnation, the cord passes through an adjustable air wiper for removing excess solution and thence vertically upward through the first saturator squeeze roll. This squeeze roll has adjustable loading for varying the padding pressure applied to the cord passing through the nip of the two rolls.

(2) THE SOAK-TIME ZONE. In the modern philosophy of cord saturation the problem of the amount of time allowed the dipped cord to remain in intimate contact with its saturant before further processing becomes exceedingly important. The soak zone provides the cord with additional time for absorption of the solutions into the fiber interstices.

The presaturation unit which precedes the soak oven is equipped with a simple, but very effective means of varying the saturation soak time at any cord speed.

(3) THE SECOND SATURATOR UNIT. The second saturator in the line receives the cord continuously from the presaturation soak unit and automatically tensions or stretches that cord prior to passing it directly into the latex or final adhesive solution. Extra-sensitive tension devices are electrically interconnected into the drive of the squeeze roll system so that precise comparative studies of the ratio of cord tension to solids pick-up can be made under various chemical and operating conditions.

After tensioning at any chosen value, the cord is propelled into the saturation tank, also provided with variable immersion sheave systems to allow for wide latitude in submersion times.

The excess solution is again removed by an adjustable air wiper, and the cord is passed directly through the nip of squeeze rolls for reducing additional free moisture in the cord to a lower level. Extra-sensitive tensioning devices in this zone allow for evaluations of the wetting in relation to shrinkage tensions of the materials being studied.

In order to investigate the effects of temperature on latex or resin dips, the dip tank can be equipped with controlled heating or cooling means, if required.

(4) THE TENSION DRYING ZONE. After second impregnation, the cord conceivably is ready for the removal of the solution moisture under conditions of precise elongation and drying conditions. This is accomplished in the tension drying zone, which allows drying time limits within a range of from 7½ seconds to five minutes. High-speed convection heating is used for the evaporation of moisture under the supervision of an accurate temperature control system.

The handling sheaves over which the cord travels are so mounted that they can be arranged completely within the drying zone or outside the drying zone, (for heated or cool sheaves) as dictated by the work being performed.

This zone is equipped with a bypass system so that the cord may be cooled in ambient air under conditions of controlled tension.

The sheave system is so arranged that the cord can be passed out of the system at either end.

(5) THE INTERMEDIATE CAPSTAN SYSTEM. After leaving the tension drying zone, the cord passes through a counterweighted, low-inertia dancer, which controls the speed of the capstan motor propelling the cord directly through the drying zone. The ranges of tensions are very wide, being considerably beyond the operating ranges used in prototype production practice.

The capstan is a fleeter type, and the cord is positioned against the capstan by means of a spring-operated cot roll.

(6) HOT STRETCH ZONE. The generally accepted method of processing hydrophobic fibers requires heat setting or orientation of that fiber for a desirable increase in fiber strength with a corresponding reduction of the fiber elongation under load.

The third Computreater heat zone is the hot stretch zone in which such materials may be treated under conditions of relatively high temperatures, relatively greater tensions, but for relatively shorter periods of

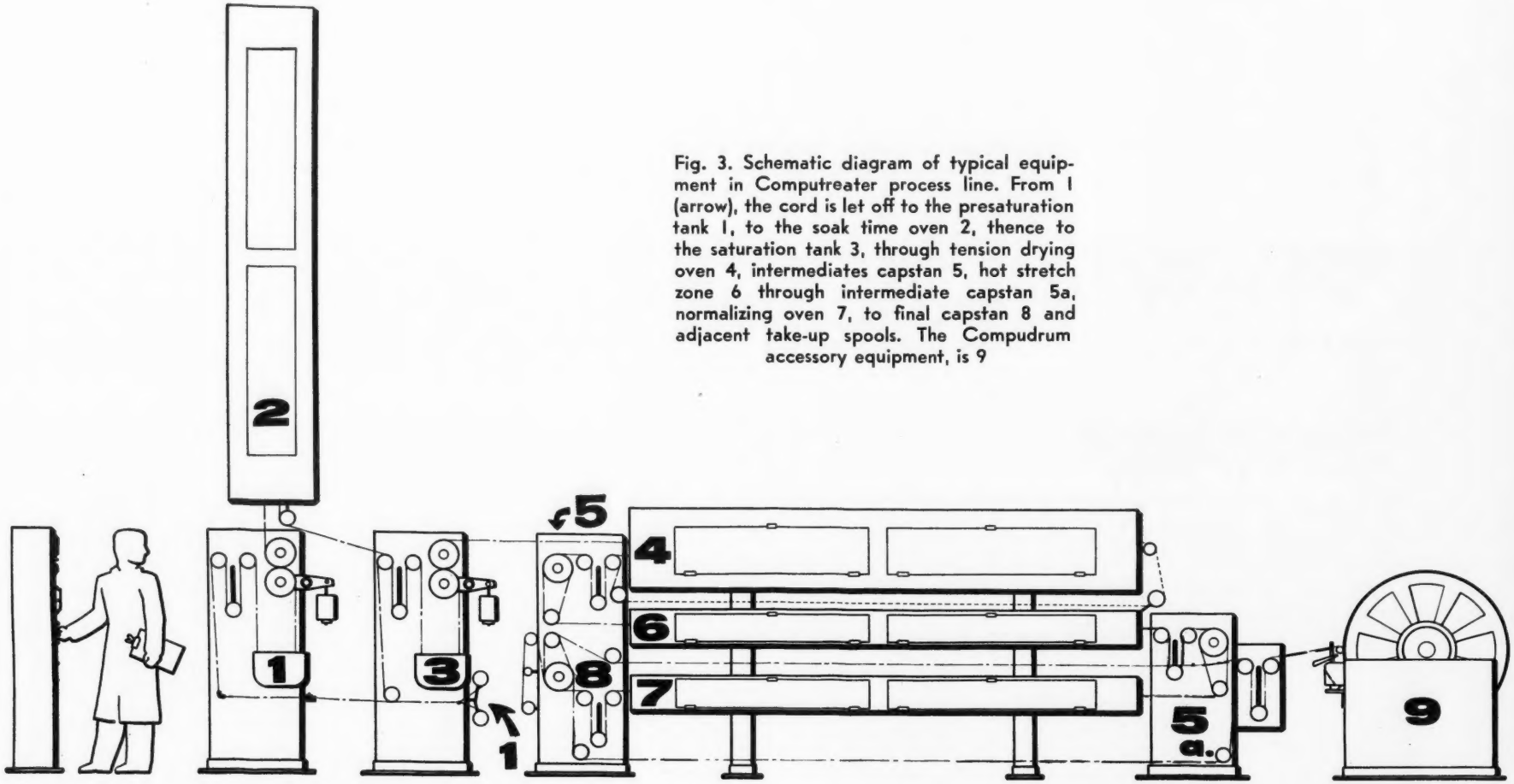


Fig. 3. Schematic diagram of typical equipment in Computreater process line. From 1 (arrow), the cord is let off to the presaturation tank 1, to the soak time oven 2, thence to the saturation tank 3, through tension drying oven 4, intermediates capstan 5, hot stretch zone 6 through intermediate capstan 5a, normalizing oven 7, to final capstan 8 and adjacent take-up spools. The Compudrum accessory equipment, is 9

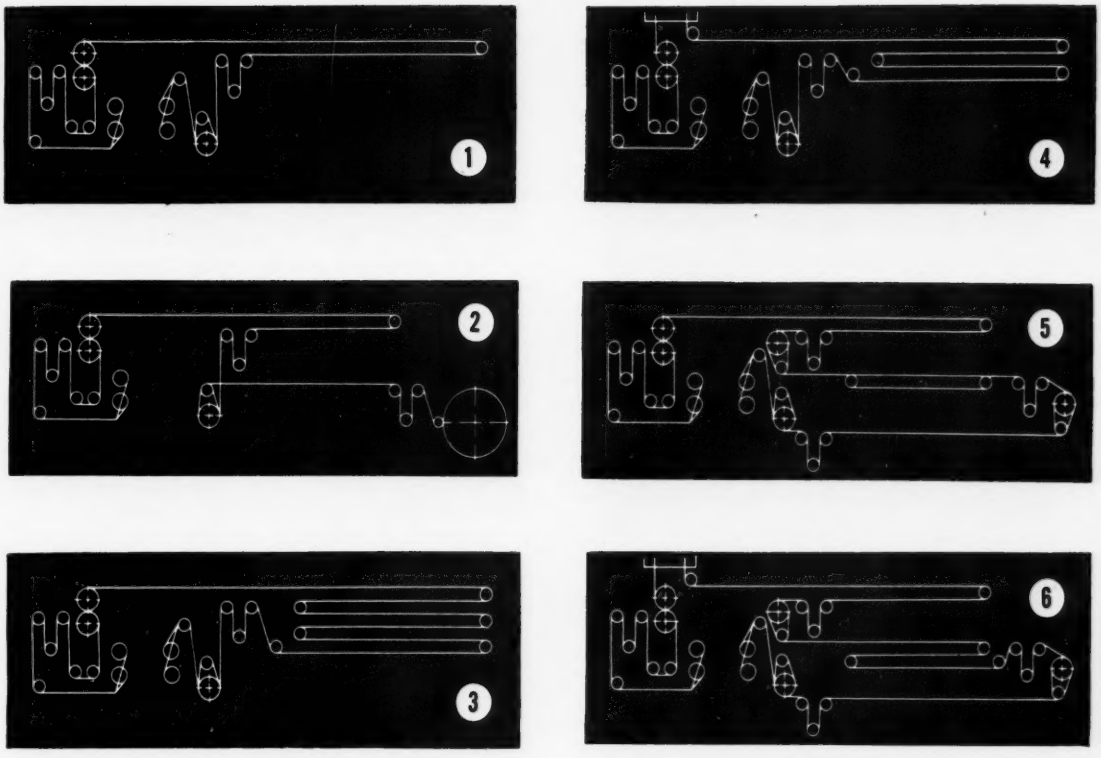


Fig. 4. These six flow diagrams illustrate a few of the many treatment possibilities and are described more fully in the text

time. In the cases of tensions and stretches greater than those employed in the drying zone, the capstan acts as a snub or holdback roll for the normalizing zone. Operating temperatures reach a controlled maximum of 600° F.

(7) THE NORMALIZING ZONE. The cord feeds into the normalizing zone from the intermediate fleeter capstan 5a. In this normalizing or shrinkback zone, the cord is treated under conditions which may not be so severe as those encountered in the hot stretch zone, to allow the cord to lose some of its heat-set elongation and thereby gain an improvement in crystalline structure.

In design, the normalizing system is similar to the hot stretching system, having the same wide latitude of operation. A wide range of heating times is provided, with maximum temperatures to 600° F.

Convection-heated air is directed normal to the cord at high velocities so that the cord is subjected to extremely large numbers of air changes per minute.

This normalizing equipment is provided with either external or internal guide sheaves to allow as many as eight longitudinal passes through the unit.

Suitable bypass sheaves and/or cooling passes allow travel of the cord under controlled tension from either end of the unit, with cooling in ambient air.

Upon leaving this unit, the cord passes into a low-inertia tension dancer and thence around a multiple-wrap fleeter-type capstan, equipped with a spring loaded cot roll to provide maximum grip with the minimum number of wraps. The cot roll in this capstan, as in the system's other capstans, also serves to hold the threadup on the capstans in the event of a cord break in any portion of the system.

(8) THE FINAL CAPSTAN AND TAKE-UP UNIT. After leaving the normalizing zone, the cord is again tensioned by means of a low inertia dancer system interlocked electronically into the final drive capstan motor. This drive motor drives the final capstan and provides controlled final speed and tensioning for the normalizing zone.

The cord, after leaving the capstan, passes through a series of guide sheaves and thence through a traversing mechanism to either one or two tension-controlled winding spools.

The general threadup arrangement briefly described here is that which might be used in a complete experimental tire cord treating system.

Triple-zone nylon treatment might be effected with this same equipment line-up merely by readjusting the system to provide tension drying in the presaturation soak unit.

This simple addition of a capstan and oven unit to this basic line-up would provide for experimental work on double-dip-and-dry treatment in addition to triple-zone nylon heat-set processing.

Computreater Application Versatility

An indication of the flexibility of operation of such a system is given in Figure 4, which gives six flow patterns

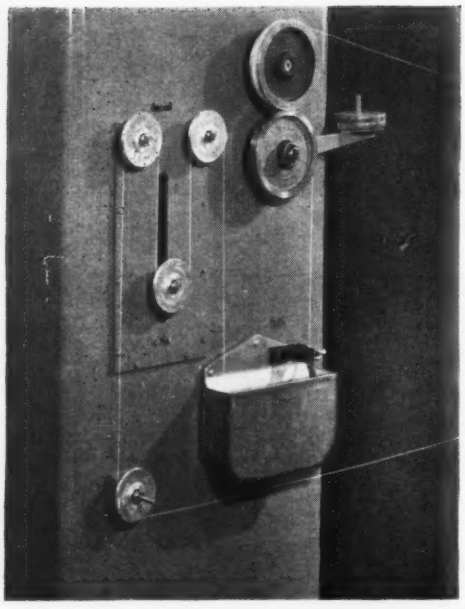


Fig. 5. Close-up of impregnation system showing the three-roll tension dancer, two-quart stainless-steel immersion tank with top-mounted air wiper, and padding squeeze rolls with calibrated pressure weights cantilevered from the bottom roll

as a few of the many processing possibilities with this basic equipment. Multiple sheaves, bypasses, and zoning arrangement give an almost infinite number of paths through the equipment for every conceivable plan of treatment.

Flow Pattern 1 indicates elemental investigation of single dipping and tension drying on a short-time in-and-out basis.

Pattern 2 shows the same arrangement with the addition of the building drum for immediately plying up the cord in a rubber sandwich.

Pattern 3 shows a thread-up that would be used for single-dip processing with longer drying times.

Flow Scheme 4 indicates threadup which would be used on presaturation soaking, latex dipping, and tension drying.

Pattern 5 indicates a single dipping operation with tension drying, long-time heat setting, and short-time normalizing.

Scheme 6 indicates single dipping, short-time tension drying, intermediate-time hot stretch, and short-time normalize.

These examples indicate only a few of the processing possibilities available with the Computreater unit.

Component Systems Detailed

THE IMPREGNATION SYSTEM. Because of the increased operating speeds demanded of today's cord-and-rubber products, the necessity of enhanced cord-to-rubber adhesion values becomes extremely significant.

Refinement in overall chemistry of adhesives for optimum absorption, as well as improved application procedures, is equally important.

The variables of dip solution used, temperature of the impregnant, the solids content of the solution, the tension of the cord and its wicking capacity, all require investigation and process development for optimum cord conditioning. Various cord materials react differently in their absorption rates, therefore the solids picked up vary with the factors mentioned above.

The impregnation systems of the Computreater unit provide wide latitudes of time and tension for the careful investigation of dipping variables. The simplest version of the basic impregnation system is indicated in Figure 5.

A wide latitude of impregnation time is possible by varying cord threadup.

Sheave arrangements permit the cord to be flexed sufficiently to open the twist moderately to allow for inner penetration of the solution if required.

Either the presaturation dip tank or the latex adhesive dip tank (which hold approximately two quarts) can be provided with overfeeding devices so that the cord is passed into the solution at absolute minimum tension.

A totally enclosed pressure-controlled air wiper removes excess solutions and allows them to drain back into the tank. Variable-velocity compressed air can be provided to the wipers so that more or less solution can be removed as desired.

As non-sparking construction is used in the impregnation system, explosive-type solvent dips can be readily handled.

After leaving the dip tank, the cord passes through padding squeeze rolls, one of which is chrome plated and the other rubber covered with a non-adhesive compound, which eliminates the problems of build-up as regards the various types of latices currently used.

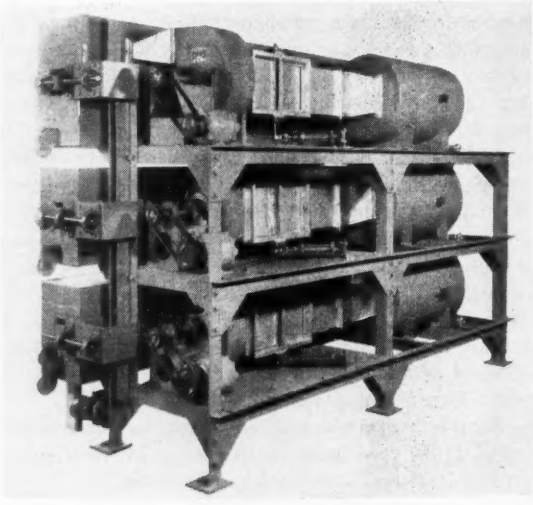


Fig. 6. Rear view of gas-fired ovens before installation of combustion controls. Pneumatic cylinders at center operate quick-cooling damper doors

The bottom roll is pivoted so that various nip pressures can be readily set.

The tanks can be arranged for heating and cooling conditions with immersion thermostats of stainless construction.

THE HEATING EQUIPMENT. Many important advantages, such as wide operating range, high rates of heat transfer, and the ability to handle explosive solvents, dictated the use of high-velocity convection heating in all the ovens in the system.

The basic convection system not only delivers heat to the work under conditions of controlled temperature, velocity, and humidity, but also provides for the rapid disposal of either solvent or water vapors driven from the cords during drying.

In the initial drying oven, heated air impinges at high velocity at right angles to the cord pass. In the heat-set and normalize zones, it is passed back and forth across the cords as they travel in a horizontal position.

Prototype machine practices have been employed in the oven design, and the ratio of air volume circulated to the pounds of cord produced has been carefully balanced.

Such balance is important with the appreciation that, in a convection system, heating of the cord from two sides with high-velocity air reduces the drying or heat-up time and provides a treated cord assembly in which all of the individual filaments are equally heated and therefore of equal diameter. Cross-sectional photomicrographs indicate that heating the cord from one side, heating the cord at different air velocities on opposite sides, or in different air flow patterns on each side, produce an erratic cord whose filaments vary greatly in diameter. This condition indicates non-uniform heat setting with the thinner-diameter filament more overtreated than the thicker filament cords.

The basic heating system may be electrically operated, direct gas fired (Figure 6), or can utilize any other source of fuel convenient to the installation.

The maximum temperature range in any zone is 600° F., but higher temperatures are readily available if the process development planned requires a higher degree of heat.

All the oven zones can be provided with automatically operated quick-cooling equipment, a desirable feature in many cases.

The Basic Cord Drive System

The Computreater cord drive system consists of an integrated group of variable speed d.c. gear motors. These motors have matched field characteristics and shunt motor operating characteristics universally recognized as best suited to adjustable speed operation.

Power for the various drive motors is obtained from mercury-arc rectifiers operating from a.c. power lines, producing direct current at the spot required, i.e., adjacent to each motor.

Individual speed control is obtained by adjustment of a potentiometer setting. Thus by adjusting grid current control of the thyratron tubes through a feedback circuit, the system establishes the proper armature voltage required to produce the speed desired at each given capstan.

The operating controls for each drive motor are located on one central panel along with a continuous indication of cord speed on the same panel board.

The two basic modes of operation for the Computreater drive system are either constant cord tension or constant cord stretch.

Under *Constant Tension* operation, the latex-dip unit drive is considered the lead unit of the system. The speed of the line is controlled by manually setting the speed potentiometer of the latex-dip drive to the desired speed. Cord shrink or stretch is readily controlled at will.

The operating selector control of each of the other drive motors is set to "Automatic," which shifts their control from their individual manual potentiometers. The counterweighted dancers are then loaded with precisely calibrated weights to give the required tension in each zone. Each motor will accurately follow the lead motor speed with whatever incremental speed differential is necessary to maintain the predetermined tension value in the cord.

Under *Constant Stretch* operation the control of each drive motor is set to "Hand," which allows the operator to set the speed of each drive at whatever value is required to obtain the desired amount of stretch (or shrink) in the cord. A 10% difference in speed between two adjacent drives will produce a 10% stretch (or shrink) in the zone between the two drives. A wide stretch range which provides ratios as high as 50:1 makes possible even the orientation of extruded plastic monofilaments of various cross-sections.

Individually, the zones may be run under constant stretch or constant tension, quite independently of each other.

The main control panel-mounted selector switches, in addition to "Automatic" and "Hand," have an "Off" position for all drives except the lead-motor. This "Off" position will lock-out any drive at any time when the full complement of tension zones is not required.

Additional features on the operator's control panel consist of pilot lights for each drive to give visual indication as to which units are operating at any given time, a system "Start" and "Stop" push-button, and a system "Run Jog" selector switch.

Process Control And Instrumentation

The process control and instrumentation falls into three major categories: (1) the control of the heating systems in the various oven zones; (2) the control and indication of the cord electrical drive system; and (3) the recording indicating and/or controlling devices, which directly supervise physical cord characteristics.

The selection of process control can be made from several different classes of instrumentation, depending on what avenues of research and experimentation are to be explored, as well as what fuels are to be used.

TEMPERATURE CONTROL INSTRUMENTATION. Standard instrumentation for the control of air temperatures

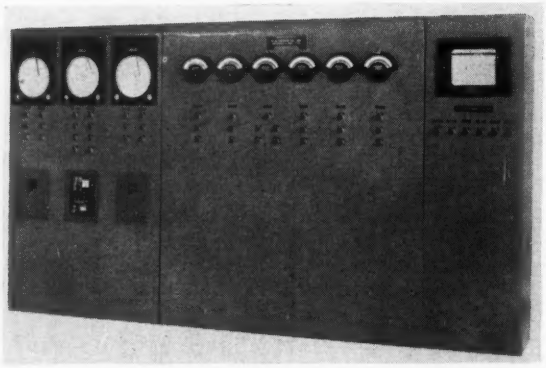


Fig. 7. Control panel for gas-fired system. Left panel: tap bank, recording temperature controls; bottom bank, combustion controls. Center panel: individual drive controls with mirror-backed tachometer indicators. Right panel: stretch recorder control

employs proportioning-type instruments. The standard control arrangement used with *electrical heating* utilizes load interrupting-type controllers which receive their control intelligence from a Wheatstone bridge resistance unit. The change in electrical resistance due to temperature setting alters current-carrying capacity and modulates the power supplied to the heating elements. Load anticipation features are also provided in this instrumentation.

For *gas-fired heating* systems, air operated, potentiometer- or thermometer-type temperature recorder controls are used in all cases.

The recording or indicating instruments are of the proportioning type with 10% throttling range or greater, as required by the control accuracy desired.

Accompanying gas-fired electronic combustion controls are conveniently mounted on the control board, seen as the left-hand panel in Figure 7.

Cord Electrical Drive System Instrumentation

In the standard unit the speed of the drive capstans and squeeze rolls is indicated by remote control tachometer dials, mounted on the main panel board. Precision tachometer generators directly geared to the d.c. drive motors provide the primary source of the current measurement. The dial gage is calibrated in yards or meters per minute.

The sensitivity of this standard speed measurement is in the approximate neighborhood of 1½% total accumulated error.

In cases where very precise tension indication is required to an accuracy of within 1%, mirror-backed scale tachometer dials are furnished. They indicate voltage output of precision tachometer generators direct-shaft driven from the main d.c. drive motors.

If further accuracy of indication is required, folded scale tachometer scales are used, which give a total scale face of 60″. With optical errors of speed reading greatly minimized, extremely accurate observations are possible.

If cord shrink and/or stretch recording is required, precision strip chart recorders are provided. These recorder charts are of the center-zero type, with the shrink being recorded negatively and the stretch being positively recorded. Accuracy of the recordings are ±¾% of the total instrument range.

Using a system of interlocking selector switches, it is easily possible for the operator to provide an accurate record of the shrink or stretch relation between the various pull rolls and capstans in any portion of the system. For instance, the overall stretch through the complete process might be recorded, or the stretch in the normalizing zone only, or the shrink in the soak zone. This is rather extensive instrumentation, but it provides a positive and accurate record of the types of stretch or shrink encountered during the experimental work.

Precise tachometer speed-control matching on an automatic basis can also be provided if this highly automatic control feature should be desired in special investigations.

There are many other basic types of greater or less sensitive control systems, which can be provided to suit particular requirements.

Besides the devices and control adjuncts just described, there are applications where it is desirable to add extra measuring devices and auxiliary testing equipment, which operate directly on the cord, independent of any of the drive or temperature system.

Among the items which can be applied to the basic Computreater system are the following: cord yardage counters, cord tensiometers, tension compensators, stroboscope for measuring high speeds of operation, and equipment for measuring cord shrinkage.

The Tire Fabric Building Drum

The complete versatility of Computreater unit in tire cord investigations is realized with the inclusion of the accessory building drum in the system. Rubberized piles for experimental tires are produced economically and quickly with the unit, and the net analysis of cord

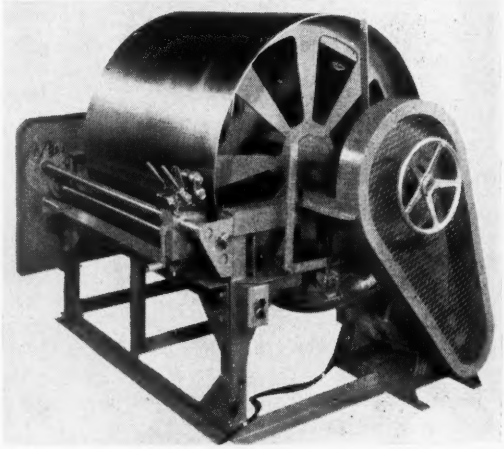


Fig. 8. Compudrum for preparing rubberized tire fabric

treatment can be measured in terms of actual casing tests, dynamometer or road.

The drum (Figure 8) is so arranged that it provides a continuous band of fabric and rubber sandwich, taking the hot cord directly from the process, just as in prototype calender train practice. If only preliminary testing is required, this drum can produce any-size swatches of the combined rubber and fabric assembly.

As the Compudrum is complete with its own synchronous drive and its own cord tension control, a wide latitude of operating conditions can be obtained as the cord is being applied to the rubber stock. Fabric produced on the drum can simulate full-width fabric produced on a production calender under widely different precalender tension conditions.

The range of cord spacing available on the Compudrum extends from eight to 34 ends per inch, allowing wide latitude for experimentation on cords of larger or smaller construction than those more commonly used.

Using the full width of the drum, 48 square feet of rubberized fabric can be produced. The drum assembly need not necessarily be used to make full width or a completely circular rubberized fabric band.

As a step into the near future, the Compudrum can be provided with pantograph traverse guide assemblies to lay up various patterns of cord configuration as are being considered for the very new band-type tire.

Instead of the plain helical layup as is conventionally used, the cord can be traversed in double or triple reversed helical angles, compound helixes, wigwag patterns, sine wave patterns, and in a wide variety of complex cord layup patterns which must be investigated and studied as one aspect of a new concept of more perfect tire design.

The Computreater At Work

Some idea of the scope of usefulness of the Computreater may be obtained from the specific research programs to which individual companies have assigned the units. Companies which have installed or plan to install units cover the whole spectrum of the reinforced rubber assembly field and include major fiber producers as well. All indications are that the Computreater is expected to provide standard measurements of fiber treatment and performance which may be interchanged between various segments of the industry for the benefit of all.

Computreater deliveries, which began six months ago, have now placed nine units at work, with an additional quantity of five being constructed for delivery to other purchasers. Of these units, nine are scheduled for research in the fiber production field; while five are involved in rubber industry research.

Typical of the immediate fields of investigation which have been planned are:

(1) Thorough study of heating, impregnation, stretching, and final orientation of a particular fiber at very precise and low rates of stretch.

(2) Detailed research on drying tensions and tension rate applications in relation to ultimate elongation of various cord assemblies.

(3) Investigation of pickup and absorption rates of cord assemblies constituted by various synthetic material types over a wide range of immersion tensions.

(4) Intensive study of the whole problem of the drying mechanism.

(5) Study of the fatigue value of cords impregnated with solutions of varying characteristics in relation to drying tensions.

(6) Technical evaluation of various synthetic reinforcing monofilaments of unconventional cross-section.

(7) Production of test tires covering a wide range of process variation and fiber types.

Special Computreater Adaptations

Several Computreater units have been built to be capable of handling five ends of cord simultaneously through all the processes. Operating flexibility and process instrumentation of the five-end units are equivalent to those of the standard single-end machine.

The five-end unit represents an intermediate capacity tool which operates as a dual-purpose machine. On all preliminary investigation and process determination, the line is run on a single end only. As especially promising results are achieved in this laboratory phase of research, the line can be promptly converted to pilot-plant operation at full five-end capacity to produce a substantial amount of cord for extensive processing.

In the case of special order V-belts or small conveyor belts, the five-end unit could even represent an economical production machine.

The unit has also been engineered with some minor variations and additions to be fully capable of doing specialized experimental work on the handling of wire tire cord. The problems of pretreatment, precalendering, cementing, and plating can be readily studied and solved on the single-end Computreater basis. Continuous decreasing plating or cementing units can be incorporated, and when such an installation is operated in conjunction with the tire fabric building drum, it is a simple matter to produce rubberized fabric for the direct building of wire reinforced tires.

The Computreater is readily adapted to the use of explosive solvents, and several of the machines already built are so arranged. The Computreater's capacity to handle these volatile materials safely brings to mind a number of specialized uses for the equipment.

The unit will operate on material of other than perfectly round cross-section, which suggests a number of uses for the wire and tape industries. It might readily be used, for example, in conjunction with a plastics processing extruder for orientation simultaneous with production.

The question of fuel supply presents no problems in the application of the Computreater. The standard unit can be furnished to utilize electricity or direct-fired natural, manufactured, or LP gases, or it can be adapted for indirect oil heating.

The unit is adaptable spacewise to almost any available area in the laboratory, the compound room, or any other suitable location. In addition to completely flexible floor-plan arrangement of units, the Compu-

treater may even be furnished in a vertical installation if desired.

A Look Ahead . . . .

The basic Computreater concept, i.e., providing the means for rapidly discovering and measuring the effects of process variation in terms of the final product, is one which is in the best tradition of modern, scientific production management.

The Computreater has, however, a series of much broader application possibilities in this same direction.

The most obvious of these (one already under consideration for immediate use) is the installation of a unit to operate in parallel with a full-width production machine in continuous supervision of quality control.

In such an application the production unit and the Computreater are electrically interlocked so that operating conditions on the production floor are exactly duplicated in the laboratory by remote control. Thus the Computreater becomes a continuous single-end testing machine providing a cord processed identically to the conditions existing at any time on the large machine.

The single-end laboratory cord can be intermittently tested for load elongation, moisture, latex pick-up, etc., and this intelligence used to make adjustments, as needed, on the large machine to maintain the proper output quality.

Even more interesting as a possibility for the near future is the utilization of the Computreater as an essential element in automated production.

First step in this direction, which has already been detailed, is the transfer of Computreater process data to a punch-card system. The Computreater punch-card is inserted into a card reader, which in turn feeds the data to an automatic control unit which makes all line adjustments on the process machinery.

Each roll of raw fabric may have its own card punched out in accordance with Computreater laboratory data, and as this roll progresses through the system, the process machinery will adjust itself accordingly, controlled by the preset data on the process card.

Thus precise treatment formulae produced by the Computreater may be used in direct control of production without involving the human factor in making the many settings and adjustments required. This represents the first big step in automation, that of putting the entire process line under automatic control.

The next automation step indicated is a closed-loop control system whereby the parallel interlocked control Computreater—described above—is augmented with continuous testing equipment. This equipment, presently under development by several manufacturers, would report deviations from established quality levels direct to an analyzer computer. The computer would calculate the necessary process adjustments for the process line and deliver instructions by punched tape. The control unit of the large machine would establish the necessary corrections simultaneously.

Here, with a continuous automatic closed-loop control under laboratory supervision and the process line running as a follower, is an ultimate system of control within the range of technological development for the near future.

Mooney Viscosity

(*Continued from page 700*)

following examples illustrate the usefulness of the chart.

Example 1—The optimum temperatures for stocks of varying Mooney plasticity. Referring to Figure 7 with a material of 25 plasticity and a temperature of 80° C., it is shown that we can use a rate of 2 lbs./min. If, however, the stock has a gage reading of 50, then a temperature of 120° C. must be used for a fill rate of 2 lbs./min.

Example 2—Maximum rate of fill with a stock of constant Mooney value. Using a stock of 40 Mooney viscosity, the rate will be 1.5 lbs./min. at a temperature of 100° C., but the rate can be increased to 7 lbs./min. at 140° C.

Example 3—The maximum stock plasticity with a maximum temperature and minimum fill rate. If the most economical process is based on a maximum temperature of 100° C. and a minimum fill rate of 3 lbs./min., then 32 is highest Mooney value stock which can be used. If the maximum temperature were 120° C., then rubber stocks with Mooney viscosities as high as 44 would be satisfactory.

Summary and Conclusions

In molding electrical apparatus it is important that the forces on the component parts do not exceed a critical value. The equations of the Mooney viscometer and the author's data with butyl rubber were used to develop a chart which allows one to select the variables of the molding process, such as, rate of fill, stock temperature, and the Mooney plasticity of the stock so as not to exceed the critical force.

The author wishes to acknowledge the assistance of F. Frank, who obtained much of the experimental data, and the helpful discussions with R. A. Pfuntner, of General Electric Co.

Correction

The article, "Light-Colored, Non-Blooming Butyl Rubber Compounds," by R. O. Treat and J. E. Aller, in our January, 1958, issue reports, in Tables 2, 3, and 7, compression set values according to ASTM Method B, D 395-55, 70 hours @ 100° C. The conditions in all instances in these and other tables were *22 hours @ 70° C.*

Vulcanization of Silicone Rubber[1]

By J. R. HARPER, A. D. CHIPMAN, and G. M. KONKLE

Dow Corning Corp., Midland, Mich.

Such vulcanizing agents as benzoyl peroxide, dichlorobenzoyl peroxide, ditertiary butyl peroxide, dicumyl peroxide, tertiary butyl perbenzoate, and others can be used with dimethyl siloxane polymers as well as with vinyl methyl siloxane copolymers.

Specific advantages as well as disadvantages have been found for each type of vulcanizing agent with regard to such properties as hardness, tensile strength, elongation, compression set, tear strength, and shrinkage, as well as other more specialized properties.

The presence or absence of vinyl groups in the silicone rubber also affects behavior with different peroxides. Recommendations with regard to the amount and the type of vulcanizing agent are made with each type of silicone rubber for particular applications. Optimum conditions for molding and curing are also included.

THE past few years have shown a marked increase in the compounding of silicone rubber by industrial fabricators. The greater availability of silicone polymers and the accompanying increase of fabricator compounding have brought about a need of more information on all phases of compounding. Some of this compounding information has already been published.[2-4] It is the specific purpose of this paper to give a comparative evaluation of the most effective peroxide vulcanizing agents at the present time.

Vulcanization Mechanism

Silicone rubber polymers are composed of chains of alternately arranged silicon and oxygen atoms. Two of the valences of the silicon are satisfied by a series of hydrocarbon groups. These hydrocarbon side groups determine the relative degree of reactivity of the polymer for vulcanization purposes.

Initially, silicone rubber polymers were composed entirely of dimethyl siloxane. Methyl groups are still used as the principal side groups because their low degree of reactivity causes a maximum retention of properties at elevated temperatures. The incorporation of small amounts of the more reactive vinyl group results in a polymer which has improved vulcanization characteristics.

Since the methyl vinyl type stocks were introduced in early 1953, the trend has been toward greater usage of this type of polymer. Low amounts of phenyl side groups are sometimes introduced along with the vinyl groups to lower the brittle point of the silicone rubber. These phenyl groups show little or no reactivity, as far as vulcanization is concerned, so that the presence of phenyl groups has little effect on the choice of vulcanizing agent.

The peroxide vulcanization of silicone rubber proceeds by a free radical mechanism. It is essentially the same with all of the peroxides, differing only in the rate and the degree of reaction and the composition of the by-products formed. The vulcanization reaction starts with a thermal decomposition of the peroxide, forming free radicals. These free radicals extract hydrogen atoms from the organic side groups of the silicone polymer. The activated side groups then proceed to combine with each other, forming cross-linkages.

TABLE 1. EFFECT OF DIFFERENT PEROXIDES ON VULCANIZATION

Vulcanizing Agent	Vulcanization Obtained: Dimethyl Polymer	Vulcanization Obtained: Methyl Vinyl Polymer
Benzol peroxide (BP)	good	good
Para chlorobenzoyl peroxide	good	good
Dichlorobenzoyl peroxide (Cl_2BP)	good	good
Tertiary butyl perbenzoate (TBPB)	fair to good	good
Dicumyl peroxide (DCP)	fair	good
Tertiary butyl perphthalic acid	poor	good
Lauroyl peroxide	poor	fair
Dietertiary butyl peroxide (DTBP)	fair to poor	good
Teritary butyl diperphthalate	poor	fair to good

Inclusion of vinyl groups in the polymer broadens the choice of useful vulcanization agents. This point is illustrated in Table 1.

The use of vinyl-containing polymers also allows practical compounding of carbon-filled silicone rubbers utilizing dicymyl peroxide and ditertiary butyl peroxide, neither of which degenerates in the presence of carbon.

This study concerns the five following vulcanizing agents, all of which are in current use:

(1) benzoyl peroxide (BP); (2) 2,4 dichlorobenzoyl peroxide (Cl_2BP); (3) tertiary butyl perbenzoate (TBPB); (4) ditertiary butyl peroxide (DTBP); (5) dicumyl peroxide (DCP).

As shown in Table 2, results obtained with dimethyl polymers in conjunction with dicumyl peroxide and ditertiary butyl peroxide are poor. No significant vul-

[1] Presented before the Division of Rubber Chemistry, ACS, Atlantic City, N. J., Sept. 19, 1956.
[2] C. W. Pfeifer, R. M. Savage, B. B. White, India RUBBER WORLD, 129, 481 (1954).
[3] P. C. Servais, *Rubber Age (N. Y.)*, 76, 879 (1955).
[4] F. L. Kilbourne, Jr., C. M. Doede, K. J. Stasiunas, RUBBER WORLD, 132, 193 (1955).

J. R. Harper

A. D. Chipman

G. M. Konkle

The Authors

J. R. Harper, project leader, Silastic section, Dow Corning Corp. laboratories, received his B.S. degree in chemical engineering from Michigan State University in 1953.

Mr. Harper joined Dow Corning in 1953 in the fiber treatment section, product engineering laboratories, and transferred to the Silastic section in February, 1954. His responsibilities also include production problems and customer technical service.

A. D. Chipman attended Grand Rapids Junior College and Michigan State University and received his B.S. degree in chemistry from the latter institution in 1941.

Mr. Chipman was in the U. S. Navy from 1941 until 1946. He joined Dow Chemical Co. in 1946 as a chemist in the cellulose division and transferred to the Silastic development laboratory in 1947 as a project leader, where he has remained until the present time. He is a member of the American Chemical Society and Alpha Chi Sigma.

G. M. Konkle obtained the degree of B.S. in chemical engineering from Michigan State University in 1941. He was a chemist with Frederick Stearns Co. until 1942, when he joined the U. S. Air Force where he remained until 1946.

Mr. Konkle joined Dow Corning in 1946 and was assigned to the Silastic development and product engineering section. He is the author of papers on silicone rubber published in 1947 and 1950 in *Industrial and Engineering Chemistry*. He is also a member of the American Chemical Society and Alpha Chi Sigma.

canization is obtained with DTBP. DCP will vulcanize dimethyl polymer, but the resultant properties are only fair and decline rapidly at the usual curing temperature.

Experimental Procedure

The vulcanizing agents were evaluated in the standard formulation shown in Table 3, and all moldings were vulcanized under the conditions listed in Table 4.

Precautions were taken as follows to minimize some common sources of error:

Water-cooled rolls were used in compounding to control scorching. High molding pressures were used to insure proper flow before vulcanization had started. Compounds were brought up to vulcanizing temperature rapidly to insure good surface vulcanization. With very small amounts of peroxide some surface inhibition was found.

All testing conformed with ASTM[5] methods where possible. The ASTM methods used were as follows:

1. Tensile strength and elongation according to ASTM D 412-51T.

2. Tear resistance according to ASTM D624-54, using Die B.

3. Compression set according to ASTM D 395-55, Method B, (constant deflection) at 300° F. for 22 hours. Results are given as percentage of original deflection.

The following tests are not covered by ASTM and were run as indicated:

1. Percentage of linear shrink was determined with ¼-by one- by eight-inch test bars vulcanized in a mold having the eight-inch dimension held to a tolerance of plus or minus 0.0002-inch. Shrinkage was determined as the % difference between actual length of the shrink bar and of the eight-inch mold length.

2. The determination of hot air vulcanization characteristics[6] was accomplished by extruding the material into 5/16-inch diameter rods and then placing eight-inch long sections directly into a 480° F. circulating air oven for three minutes. Samples were then observed for good surface vulcanization and the presence or absence of porosity.

3. Thick section curing characteristics were determined from moldings made by vulcanizing in a one- by

[5] American Society for Testing Materials, Philadelphia, Pa.
[6] C. D. Youngs, G. M. Konkle, RUBBER WORLD, 131, 500 (1955).

TABLE 2. PROPERTIES OF DIMETHYL SILICONE POLYMER CURED WITH DCP AND DTBP

Peroxide	Parts Peroxide	As Molded: Hardness Shore A	As Molded: Tensile Strength, Psi.	As Molded: Elong., %	Cured 4 Hrs. @ 300° F.: Hardness Shore A	Cured 4 Hrs. @ 300° F.: Tensile Strength, Psi.	Cured 4 Hrs. @ 300° F.: Elong., %	Cured 24 Hrs. @ 480° F.: Hardness Shore A	Cured 24 Hrs. @ 480° F.: Tensile Strength, Psi.	Cured 24 Hrs. @ 480° F.: Elong., %
Dicumyl (DCP)	1	15	120	1100	14	228	700	16	196	520
Dicumyl (DCP)	3	42	692	720	53	541	540	52	374	410
Dicumyl (DCP)	5	47	927	680	61	537	330	62	348	310
Ditertiary butyl (DTBP)	1	(cracked in mold—no vulcanization)								
Ditertiary butyl (DTBP)	3	(cracked in mold—no vulcanization)								
Ditertiary butyl (DTBP)	5	(cracked in mold—no vulcanization)								

TABLE 3. BASE COMPOUND

100 parts silicone polymer*
45 parts HiSil X-303†
Varied parts vulcanizing agent‡

* Silastic 430 gum or Silastic 401 gum, Dow Corning Corp., Midland, Mich.
† Columbia-Southern Chemical Corp., Pittsburgh, Pa.
‡ The number of parts used of the various peroxides are listed on the individual graphs.
Benzoyl peroxide and 2,4 dichlorobenzoyl peroxide pastes are available from either Lucidol Division, Wallace & Tiernan Inc., Buffalo, N. Y., or from Cadet Chemical Corp., Burt, N. Y.
Ditertiary butyl peroxide is available from Shell Chemical Corp., Emeryville, Calif.
Dicumyl peroxide is available from Hercules Powder Co., Wilmington, Del.
Tertiary butyl perbenzoate is available from Lucidol Division, Wallace & Tiernan.

TABLE 4. CONDITIONS FOR MOLDING UP TO ¼-INCH SLABS*

Vulcanizing Agent	Molding Time in Minutes	Molding Temp., °F
Benzoyl peroxide (BP)	5	250
2,4 Dichlorobenzoyl peroxide (Cl_2BP)	5	240
Tertiary butyl perbenzoate (TBPB)	10	300
Ditertiary butyl peroxide (DTBP)	10	340
Dicumyl peroxide (DCP)	10	300

* For thicker moldings, a longer molding time may be necessary.

two- by two-inch mold. These moldings were then placed directly into a 480° F. circulating air oven. After 24 hours the samples were removed and cut open for observation of possible degradation at the center of the molding. Degradation was noted as softness of center, discoloration, and porosity.

Effect of Vulcanizing Agent on Hardness

From the curves in Figure 1 it is evident that the type and the amount of vulcanizing agent used have an effect on the durometer hardness. Figure 1 (upper graph) shows this effect when methyl vinyl polymers are used. Benzoyl peroxide (BP), dichlorobenzoyl peroxide (Cl_2BP), and tertiary butyl perbenzoate (TBPB) give the highest durometer hardness in compounds based on this type of polymer, which might be expected since the above three peroxides are less dependent upon the presence of vinyl groups for adequate cross-linking. Increasing the amount of peroxide results in only a gradual rise in hardness except in the extremely low peroxide content range. Both DTBP and DCP show excellent stability of durometer hardness regardless of the amount used, which indicates their specificity toward the vinyl group.

As shown in the lower graph in Figure 1, TBPB gives a higher durometer hardness than either BP or Cl_2BP with dimethyl polymers.

The length of time and the temperature of the post-cure used affect the final hardness of dimethyl vulcanizates more than they do the methyl vinyl vulcanizates. (See Figure 2.) Ditertiary butyl peroxide-methyl vinyl vulcanizates show a rise in hardness similar to that obtained with the dimethyl polymer. DCP, however, exhibits a drop in hardness with an increase in cure time and temperature.

Tensile Strength

When methyl vinyl polymers were used, maximum tensile strength was developed with the lower amounts of peroxide. The tensile strength then declined gradually with the increased amounts of peroxide. A comparison of the upper and the lower graphs of Figure 3 points out the difference between the two types of polymers in this respect. The lower graph of Figure 3 illustrates the steep rise in tensile strength to a maximum when peroxide content is increased with dimethyl polymer. A further increase in peroxide results in an equally rapid decline.

Figure 4 shows that the presence of vinyl groups in the polymer rather than the type of peroxide used controls the change in tensile strength due to increased oven cure. As indicated in the graph, the methyl vinyl polymers experience significantly less drop in tensile strength with added cure. The methyl vinyl polymers vulcanized with DCP are the only exception.

% Elongation at Break

Figure 5 shows the relative elongation at break of methyl vinyl polymers with the different vulcanizing agents. Two patterns are evident. The three more reactive agents, benzoyl peroxide, dichlorobenzoyl peroxide, and tertiary butyl perbenzoate, show nearly similar curves with a rapid decline upon increasing the amount of peroxide. The less reactive DTBP and DCP produce significantly higher elongations and much less change

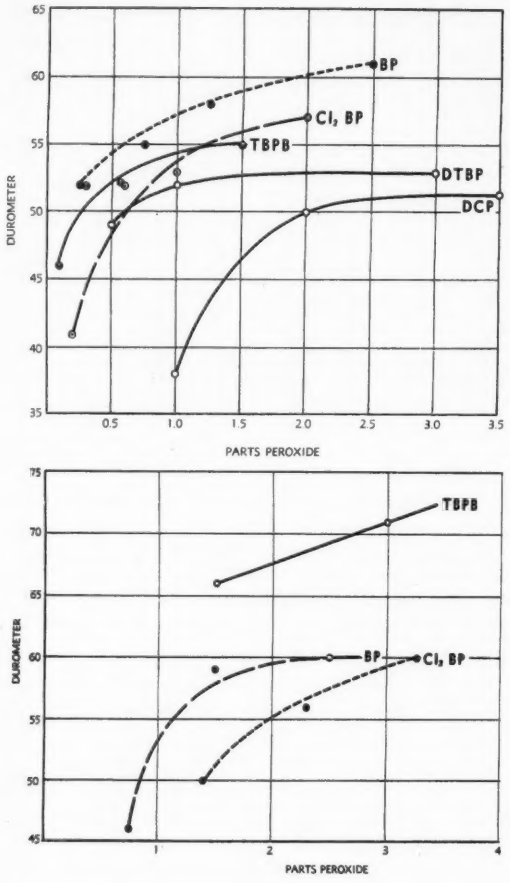


Fig. 1. Effect of type of peroxide on durometer hardness. Upper graph for methyl vinyl gum; lower graph for dimethyl gum; both polymer compounds cured 24 hours at 480° F.

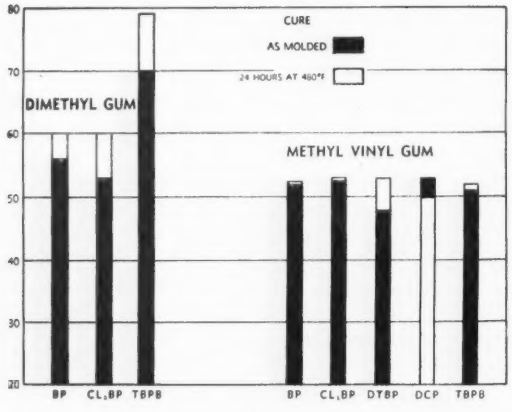


Fig. 2. Effect of curing conditions on durometer hardness, using the amount of peroxide to give maximum tensile strength

with increased peroxide content, which again points up their vinyl specificity.

A rapid decline in elongation is experienced with methyl polymers on increasing the peroxide content.

Figure 6 illustrates the difference in the effect of curing time and temperature on the elongations of both dimethyl and methyl vinyl silicone rubber compounds. As was the case with tensile strength, the drop in elongation due to increased oven cure is significantly less when the methyl vinyl polymers are used. The type of peroxide used has little or no effect.

Compression Set

The greatest difference between dimethyl and methyl vinyl polymers is found in their relative compression

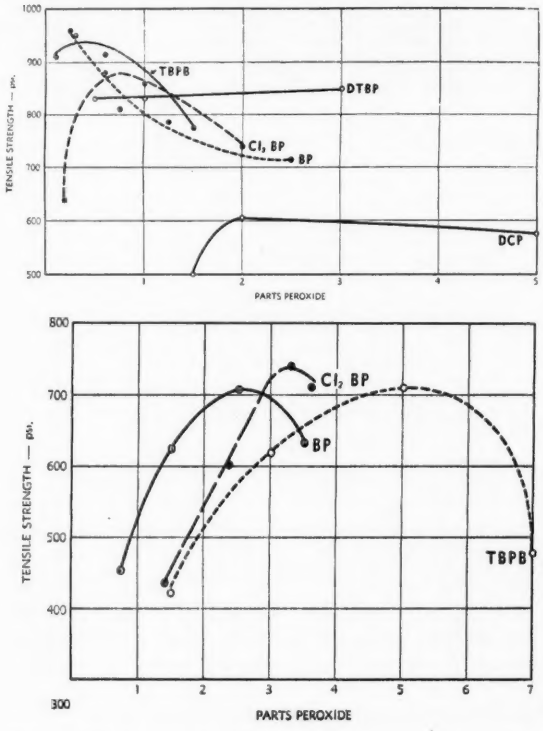


Fig. 3. Effect of type of peroxide on tensile strength. Upper graph for methyl vinyl gum; lower graph for dimethyl gum; both polymer compounds cured 24 hours at 490° F.

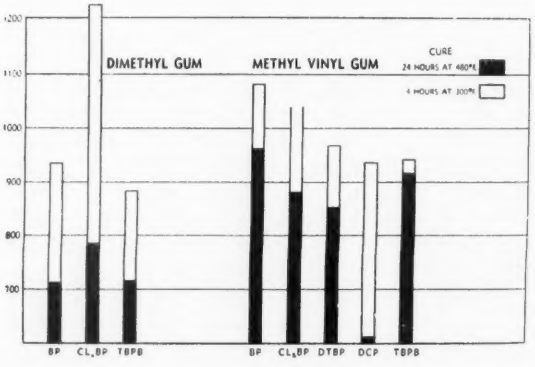


Fig. 4. Tensile strengths of dimethyl and methyl vinyl gum compounds at various cures, using the amount of peroxide to give maximum tensile

set properties. If low compression set values are desired, methyl vinyl polymers should be used. Good compression set values can be obtained with dimethyl polymers, but toxic additives such as mercuric oxide are necessary.

As the upper graph in Figure 7 indicates, compression set values obtained with the various peroxides in methyl vinyl polymers are very similar when very small amounts of peroxide are used. As the amount of peroxide is increased, the compression set rises. A spread of values then develops between the different peroxides. The upper extreme is exhibited by benzoyl peroxide, BP. The lower extreme is experienced with ditertiary butyl peroxide, DTBP. The DTBP again shows little change in value with a fairly large increase in the amount of peroxide used.

As shown in the lower graph in Figure 7, compression set values obtained with dimethyl polymers start higher than those obtained with methyl vinyl polymers. The rise in compression set is rapid with increased peroxide content except when tertiary butyl perbenzoate, TBPB, is used.

Tear Resistance

Figure 8 shows the tear resistance of vulcanizates produced with varying amounts of the different perox-

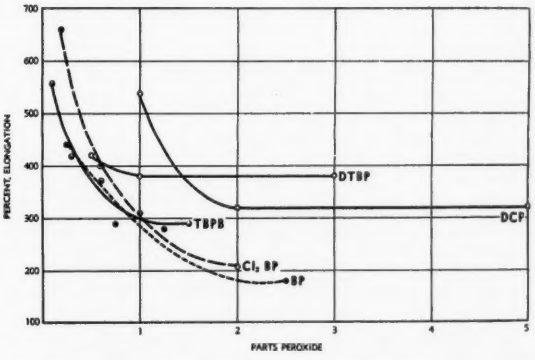


Fig. 5. Effect of type of peroxide on elongation at break for methyl vinyl gum stocks cured 24 hours at a temperature of 480° F.

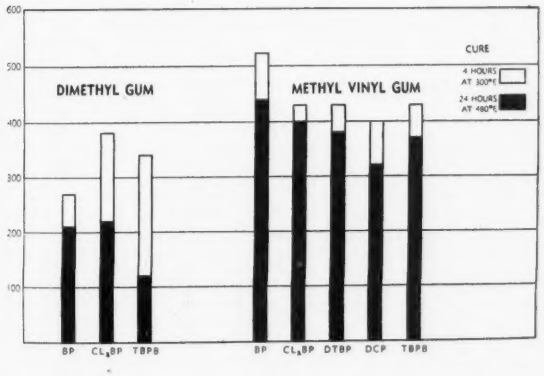


Fig. 6. % elongation at break for dimethyl and methyl vinyl gum stocks for various cures, using the amount of peroxide to give maximum tensile strength

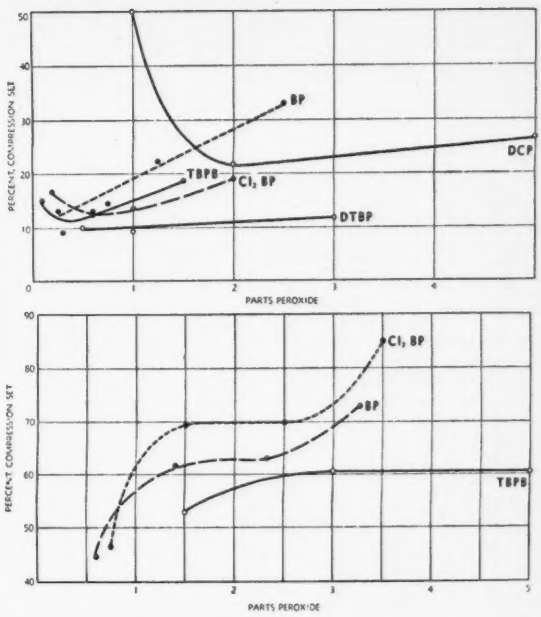


Fig. 7. Effect of type of peroxide on compression set. Upper graph, methyl vinyl gum stocks; lower graph, dimethyl gum stocks; both stocks cured 24 hours at a temperature of 480° F.

ides. When small amounts of peroxide are used, about the same tear strengths are obtained.

Vulcanizates obtained with benzoyl peroxide, BP, dichlorobenzoyl peroxide, Cl_2BP, and tertiary butyl perbenzoate, TBPB, decline rapidly in tear resistance as the peroxide content increases. DTBP exhibits the least rapid decline. DCP vulcanizates give low tear strengths when low amounts are used. When two parts or more of dicumyl peroxide are used, results are similar to those obtained with ditertiary butyl peroxide.

Linear Shrinkage

Many factors affect the shrinkage of silicone rubber after vulcanization. These are the type of filler and loading used, amount of material lost in the form of volatiles, the coefficient of thermal expansion of the material involved, and the type of polymer used.

The amount of shrinkage produced with the various vulcanizing agents is illustrated in Figure 9. Shrinkage appears to be more directly related to the vulcanization temperature than to the vulcanizing agent used. As the material is heated to the vulcanization temperature, thermal expansion takes place, and vulcanization occurs under this expanded condition. Upon cooling to room temperature, the vulcanized molding shrinks to dimensions less than those of the original unvulcanized item.

Additional shrinkage is produced through loss of volatile material, but this is about the same with the various peroxides. No significant difference was noted when the amount of peroxide was varied.

Curing of Thick Sections

Oven curing of silicone rubber parts which have a

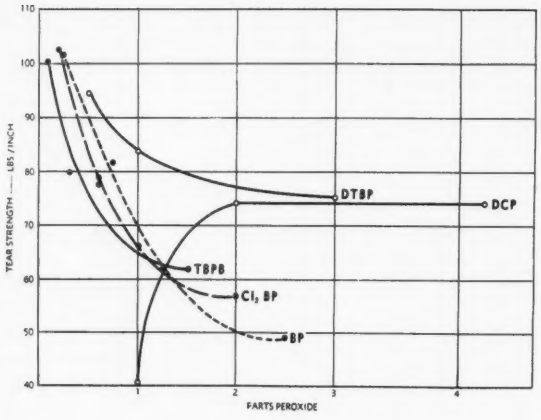


Fig. 8. Effect of type of peroxide on tear strength for methyl vinyl gum stocks cured 24 hours at 480° F.

cross-section thicker than one-half inch usually requires a precure at gradually increasing temperatures before the final 480° F. cure. If this procedure is not followed, blowing usually occurs, and discoloration at the center of the molded part takes place, as was the case with all dimethyl polymer compound samples with thick sections used in our experiments.

When methyl vinyl polymers were used for curing thick sections, however, with both ditertiary butyl peroxide and dicumyl peroxide as vulcanizing agents excellent results were obtained. With these peroxides vulcanized moldings one inch thick could be cured directly at 480° F. Differences in durometer hardness of about seven points in the case of the DTBP and approximately three points when DCP was used were noted between the outside of the molding and the center of the molding, but no evidence of discoloration or blowing was noted with these two peroxides. The amount of peroxide used had no effect once vulcanization was achieved.

Cures of fairly thick sections were obtained with dichlorobenzoyl peroxide when used in small quantities, that is, in the range of 0.6- to 0.8-part of peroxide per 100 parts of polymer. In this case no evidence of blowing was noted although the hardness was approximately seven points higher on the outside of the molding than at the center. A slight discoloration at the center of the molding, however, was evident. The use of additional dichlorobenzoyl peroxide gave successively poorer results.

Hot Air Vulcanization

Hot air vulcanization is a process for the continuous vulcanization of extruded materials.[6] It varies from the regular continuous vulcanization process, in common use for insulated wire and cable, in that the vulcanization takes place in an open, heated tube rather than in a closed tube heated with steam. With the continuous hot air vulcanization process no pressure can be applied to the vulcanization chamber.

Not all silicone rubber stocks are suitable for this hot air vulcanization. Generally speaking, methyl vinyl polymers, when used with reinforcing-type fillers and the more reactive peroxides, give the best results with hot air vulcanization.

The best results that were obtained with dimethyl polymers in this investigation were from those samples which were vulcanized with dichlorobenzoyl peroxide although the samples gave evidence of random pinhole porosity.

When methyl vinyl polymers were used, the Cl_2 BP cured samples were again found to be the most satisfactory, and this compound vulcanized completely in hot air with no evidence of porosity. BP and TBPB both produced good vulcanization, but developed slight amounts of porosity.

Neither DTBP nor DCP produced satisfactory vulcanizates by the hot air process. This failure seemed to be due to inhibition of the peroxide by air as well as a dissipation of the vulcanizing agent before vulcanization took place.

Carbon Black Filled Semi-Conducting Silicone Rubber

Semi-conducting silicone rubbers can be made by loading with carbon blacks such as Shawinigan 100% compressed (acetylene) black,[7] Statex R,[8] Vulcan C,[9] and Vulcan SC.[9] Volume resistivities in the range of from less than 500 to 5,000 ohm centimeters and surface resistivities of from 150 to 1,500 ohms are obtainable. The exact resistivity depends upon the filler loading used.

Although conductive rubbers can be formulated using a dimethyl polymer and vulcanizing with excessive amounts of benzoyl peroxide or dichlorobenzoyl peroxide, these are of little practical value. Both agents degenerate in the presence of carbon even at room temperature.

Far better results are obtained by using a methyl vinyl polymer and either dicumyl peroxide or ditertiary butyl peroxide as the vulcanizing agent. DCP is noteworthy in that it allows passable hot air vulcanization in thin sections at 480° F.

(*Continued on page* 758)

[7] Shawinigan Chemicals, Ltd., Shawinigan Falls, Canada.
[8] Columbian Carbon Co., New York, N. Y.
[9] Godfrey L. Cabot, Inc., Boston, Mass.

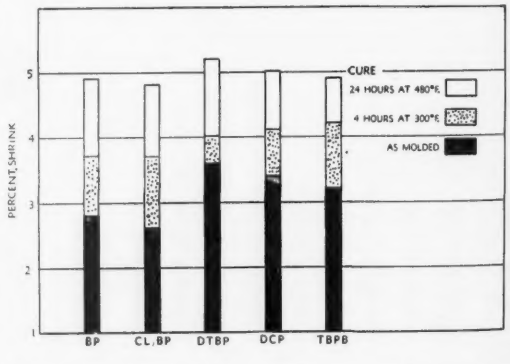


Fig. 9. Effect of curing conditions on shrinkage for methyl vinyl gum stocks, using the amount of peroxide to give maximum tensile strength

NEWS of the RUBBER WORLD

Legislation before the second session of the 85th Congress of interest to the rubber industry includes a possibility, however remote, of tax reduction; the "good faith" price discrimination bill (S-11); Senate Judiciary Committee investigation of "administered prices"; extension of the Reciprocal Trade program; and the Sadlak bill on import protection for rubber-soled footwear.

Ismail Bin Mohamed Ali, Malayan Minister to the United States, emphasized to RUBBER WORLD that his government and the Malayan rubber industry are undertaking a searching reappraisal of the position of natural rubber in future world markets.

Total new rubber consumption in 1958 in the U. S. has been estimated by government and industry at about 1.5 million long tons. Consumption in 1957 was 1,467,506 long tons. Synthetic rubber production, consumption, and export records were established in the U. S. in 1957 at 1,118,308, 928,359, and 201,474 tons, respectively.

The Office of Defense Mobilization has established a five-year research project at the National Bureau of Standards to determine the effect of mold on natural rubber, important in the maintenance of the 1.2-million-ton natural rubber stockpile.

The Federal Trade Commission is expected to publish its guide to proper tire advertising by March and to issue price-fixing complaints against major tire producers at about the same time.

The Society of the Plastics Industry reports a gain of 7% in the plastics industry in 1957 as the production of plastic and resin materials reached another new high of 4,387,000,000 pounds.

The Southern Rubber Group panel discussion on adhesion, as reported, includes comprehensive papers on rubber adhesion with emphasis on rosin and derivatives; latex tire cord adhesives; adhesives applications in the shoe, flooring, and automotive industries.

New Materials reported this month include two new room-temperature curing silicone compounds with excellent ozone resistance, low-temperature flexibility, good performance up to 500° F.; a nitrile rubber-vinyl resin blend with outstanding ozone resistance and very high oil resistance; and a special ozone resistant compound made from a carboxylic-modified nitrile rubber.

MEETINGS and REPORTS

SRG Panel on Adhesion—I

The Southern Rubber Group at its meeting in Memphis, Tenn., November 15 and 16, 1957, featured a symposium on "Adhesion," with Harold Gross, General Adhesives Co., as moderator and with papers presented by Frank H. Wetzel, Hercules Powder Co.; E. L. Borg, Naugatuck Chemical Division, United States Rubber Co.; Lee L. Blyler, Howe & French, Inc.; and S. L. Brams, Dayton Chemical Products Laboratories. The accompanying photograph shows the moderator and the panel members for this symposium.

An edited transcript of the papers presented and the questions and answers which were a part of this symposium are presented herewith.

The second symposium at this SRG meeting covered "Statistical Quality Control," and "Rubber Grading," and will be presented in future issues.

Moderator and panel members of Southern Rubber Group's Symposium on adhesion

Rubber Adhesion, with Emphasis on Rosin and Derivatives in Pressure-Sensitive Adhesives

Frank H. Wetzel

Hercules Powder Co., Wilmington, Del.

PRESSURE-SENSITIVE adhesives and solvent and latex cements represent the major portion of adhesives containing unvulcanized elastomers. Such adhesives are usually composed of an elastomer and a resin tackifier plus various modifiers, such as fillers, plasticizers, and stabilizers. Any adhesive must intimately contact the substrate (or adherend) to which it is to be adhered. Such contact is generally recognized to be necessarily on a molecular scale to bring into play the dispersion, residual valency, or polar effects that are responsible for adhesion (1).[1]

In pressure-sensitive adhesives no solvent is present to make the adhesive sufficiently fluid when applied to a substrate so as to effect intimate contact between the adhesive and the adherend. The adhesive mass itself must both wet the substrate and deform at the interface to contact the adherend intimately. This condition requires material with a relatively low modulus of elasticity as well as short relaxation times to relieve internal stresses.

The soft, rubbery systems which possess the properties necessary to effect the above, however, are also susceptible to long-time viscous flow. Under static loads to which they are subjected in use, these adhesives flow sufficiently to cause bond failure ultimately.

A different situation exists in solvent cements and, to a degree, in latex cements. Solvent cements usually contain relatively non-tacky adhesive masses, including elastomers other than natural rubber, which often are not tacky either to themselves or to other adherends. Most solvent cements are designed, moreover, to give considerably greater strengths than pressure-sensitive adhesives. This result is accomplished by means of higher molecular weight tackifiers which lend cohesive strength at the expense of adhesive tack or by the use of tackifiers at considerably lower levels than are used in pressure-sensitive adhesives.

Large concentrations of filler will also increase the strength, but at the sacrifice of tack. Therefore, the medium—whether it be an organic liquid for a solvent cement or water for a latex cement—must aid the adhesive mass in making suitable contact with the adherend and, in the last stages of solvent evaporation, act as a plasticizer to gain maximum contact between adhesive and adherend.

The latter function is especially important in cements containing elastomers such as some types of neoprene which crystallize and stiffen. This general picture is somewhat further complicated in the case of latex cements which ordinarily require heat or pressure to force the disperse adhesive particles to coalesce and form a continuous film of adhesive.

Rosin and rosin derivatives have long found considerable use as tackifiers in adhesives in combination with rubbery-type polymers. The overall good compatibility, attractive economic aspects, and contribution to adhesion of rosin and modified rosins have been responsible for the continued consumption of these products by the adhesives industry.

To understand better the function of rosin or rosin derivatives in adhesives research tools were developed to measure objectively certain adhesive properties. Pressure-sensitive adhesives were chosen as a starting point. We hope that the findings will be roughly applicable to solvent and latex systems

[1] Numbers in parentheses refer to Bibliography items at end of this article.

and that, further, the techniques will apply with some modification to solvent and latex systems.

Experimental Methods

Analysis of pressure-sensitive adhesion indicated that three properties are of basic importance: tack (also called quick-stick), internal strength, and viscosity.

Tack may be defined (2, 3), for adhesive purposes, as the property of a material which enables it to form a bond of measurable strength immediately upon contact with another surface. For pressure-sensitive adhesives, further assumptions may be made: (a) Tack is a surface phenomenon and should be measured as such. It is not a direct function of internal strength, measurement of which is made by means of tensile determinations on free films. (b) The strength of a bond formed at the surface should develop shortly after contact between an adherend and adhesive surface. (c) When such a bond is broken, failure should be interfacial between adherend and adhesive. Tack should therefore be measured as the force required to separate an adherend and an adhesive at the interface shortly after they have been brought rapidly into contact under light load of short duration.

Internal strength is measured by means of a tensile determination on free films of adhesive masses. Measurement of the cohesion of an adhesive is thus independent of a substrate.

Measurement of viscosity of rubbery elastomers of the type used in pressure-sensitive adhesives may be accomplished by several methods. These are constant stress elongation (4), constant load elongation (5), constant rate of elongation (6), and by means of the parallel plate plastometer (7). The first three methods yield complete characterization of a polymer in the elastic, plastic, and viscous region. For the present study primary need was for viscous-flow data on the adhesive mass. The parallel-plate plastometer of the Du Pont-Williams type is best suited to obtain this information.

The determination of the deformability of the adhesive mass is currently under study. This will involve dynamic methods of measurement.

TACK. In the Hercules tack tester, employing an Instron machine and a Sanborn recorder, a polished, brass probe is held in a free-sliding piston-type probe holder, which determines the load on the probe. This apparatus is shown in Figure 1. The probe slides within an aluminum pipe which is rigidly attached to a load cell. A pressure-sensitive adhesive film, supported on glass, approaches and makes contact with the probe at 20 inches per minute. After a contact time between the probe and film of one second, the film moves away from the probe at 20 inches per minute. The stress required to break the bond, recorded by means of the load cell and a high-speed recorder, is the tack. The time required to separate the probe and film is approximately 0.01-second.

Fig. 1. Instron machine and Sanborn recorder as modified for Hercules tack test

The same probe is used for five consecutive tack determinations. If tack readings become progressively higher, adhesive pickup on the probe is indicated. If strings of adhesive on the probe are visually observed or if microscopic (300X) examination of the probe surface shows the presence of adhesive, the data obtained are discarded. The requirement of true interfacial bond rupture for tack measurement is therefore checked on a microscopic scale. It is recognized that these breaks may not be interfacial on a molecular scale.

INTERNAL STRENGTH. Because of the viscoelastic nature of unvulcanized natural rubber, all of the tackifying resin-rubber films pass through a yield point when subjected to elongation at a constant rate. At low rates of elongation this yield point is the maximum tensile strength exhibited by the specimen.

It is possible to pull at a rate at which the specimen will, after having passed through a yield point, offer a pull resistance which is constant over a period of several hundred per cent elongation. If the rate of pull is increased, the specimen will pass through a yield point, reach a minimum, and then increase its resistance so that maximum tensile strength occurs at a fracture of the specimen.

Data obtained at 2000% elongation per minute indicated that at this rate the yield point and tensile strength were identical. The yield point of the free films obtained at 2000% elongation per minute was chosen as the strength property most easily measured and compared.

VISCOSITY. The theory and the application of the parallel plate plastometer in determining viscosities at low rates of shear has been described by Dienes and Klemm (7). The time-deformation curve which results from the use of the plastometer method has been described as a combination of elastic, delayed elastic, and viscous regions. The viscous portion of this curve is generally thought to be non-recoverable and usually takes the form of a straight line of definite slope. Such a straight line was not obtained from data at room temperature until the determination had run for hours or even days. This indicated that at room temperature the behavior of the tackifier-rubber mass was either elastic or delayed elastic for some time.

Determinations at 70° C. indicated that the viscous region was reached in a matter of minutes, and for this reason, determinations were carried out at 70° C. Relative differences in viscosity of various adhesive masses obtained at 70° C. are very probably the same as these which would be obtained from long times of measurement at room temperature. Subsequent determinations will, however, be carried out at room temperature.

SUPPORTED FILMS AND EFFECT ON TACK. Toluene solutions of the adhesive masses are cast on glass plates by means of a 16-mil doctor blade. A period of 16 to 24 hours is allowed to elapse before the film is solvent-free, and the tack of the supported film is tested. The thickness of the films is a function of the per cent. solids of the solution. Wet films, 16 mils thick, from a solution containing about 25% solids yield a dry film that is approximately 2.2 mils thick, as determined by differential microscopy.

Extremely variable data are obtained when film thicknesses less than 1.5 mils are used. The latter thicknesses presumably show the contours and surface irregularities of the glass plates upon

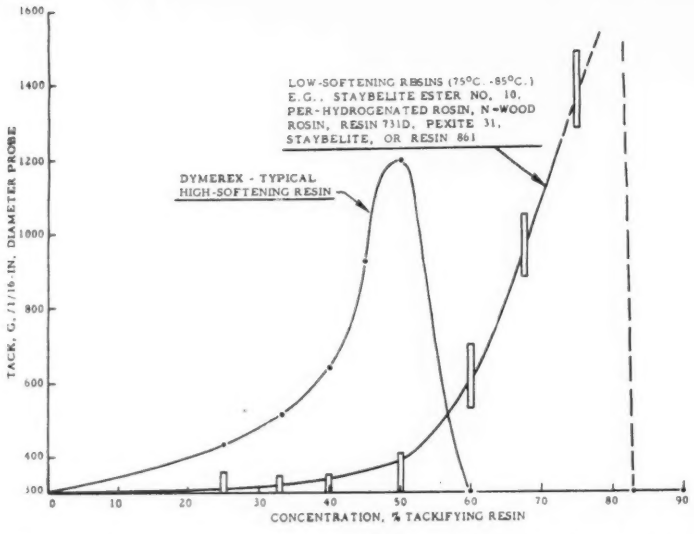


Fig. 2. Tack *vs.* concentration of tackifying resin in natural rubber for high- and low-softening resins (unaged)

which the films are cast. Ordinarily, films of 2.0 to 2.5 mils are used. Use of thicker films has been found to have no effect.

Statistical analysis of experimental data indicated that good reproducibility was obtained as long as solution preparation, film preparation, preparation of substrates, drying times of solvent-cast films, and the times of ambient aging before tests were reasonably reproduced from day to day. The reproducibility of tack data from accelerated aging of the adhesive mass, however, was found to be extremely sensitive to the aging conditions and to the length of time elapsing after accelerated aging was stopped, but before testing for tack. It was especially important that the time elapsing between the end of accelerated aging and testing for tack be as short as possible and be reproduced from day to day.

Free Films. Free films, 20 mils thick, of adhesive mass were prepared by toluene-solution casting on amalgamated tin plate (4) or Teflon[2] sheeting. The amount of drying required for the film to become solvent-free was determined by extraction of residual toluene from a weighed sample of film by isooctane and determination of toluene in the extractant by means of chromatography, or by extraction of toluene from a weighed sample by refluxing the sample in an ethanol-heptane azeotrope. The concentration of toluene is then determined by ultra-violet absorption of the extractant.

Discussion of Results

Properties, as a function of composition, were studied in a simplified system which consisted only of a resin tackifier in natural, unvulcanized rubber. The use of additives such as fillers, plasticizers, and stabilizers, was intentionally avoided. Consequently any adhesive properties obtained for an aged or unaged resin-rubber system could be ascribed solely to the resin tackifier being studied.

Unaged Adhesive Results. No increase in tack over that of rubber was detected at concentrations of less than 20%-40% of tackifying resin. These facts are illustrated in Figures 2 and 3. Thereafter the tack increased quite rapidly to a maximum. In the case of the high- and intermediate-softening resins, after maximum tack had been reached, tack decreased rapidly to zero as tackifier concentration increased.

For low-softening resins, however, "legging" prevented the measurement of tack at resin concentrations above 70%, but below 83%. "Legging" is the pulling of strings of adhesive out of the adhesive mass and is presumably caused by the inability of the adhesive to undergo rapid deformations and retractions. This violates one of the experimental assumptions. We, therefore, could not measure the maximum tack obtainable in all instances.

The resinous tackifiers studied do not readily lend themselves to a classical melting point. On the contrary, the characteristic physical property most easily measured is a softening point (8), and this is, in truth, a viscosity measurement. The shape of the tack *vs.* composition curve was generally similar for all resins studied. The concentration of tackifier in natural rubber at which maximum tack was obtained varies from 50 to >75% and correlates inversely with the softening point or viscosity of the resin. (See Table 1.) The higher the softening point, the lower the per cent resin at which maximum tack was obtained. Resins of lower softening point, moreover, provided greater obtainable tack, but at a higher concentration.

Accelerated Aging. A variety of resins was aged in resin-natural rubber formulations. Accelerated aging was carried out to compare stabilities of tackifying resins in an elastomer. In order to avoid concentration effects of the resin, aging was conducted at the same concentration for all resins, that is, a composition of 3.2 resin:rubber. This concentration represented a compromise between the optimum values for intermediates and high-softening resins.

Accelerated heat aging was carried out in a forced draft oven at 200° F. This procedure probably caused largely an acceleration in oxidation. The temperature was defined so that aging oc-

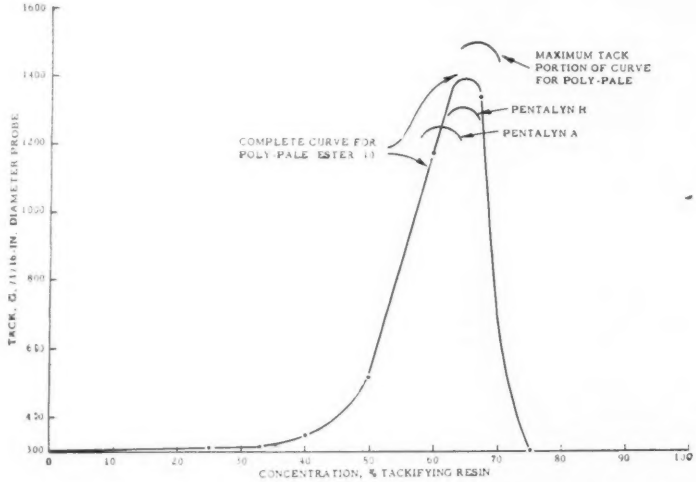


Fig. 3. Tack *vs.* concentration of tackifying resin in natural rubber for intermediate-softening (100-115° C.) resins (unaged)

[2] E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

TABLE 1. DATA ON ROSIN-BASED TACKIFIERS

Tackifier*	Softening Point °C. (8)	Resin at Which Maximum Tack Is Obtained, %	Tack at Maximum Level, G.
"Dymerex"	150	50	1200
"Pentalyn" A	111-114	61	1250
"Poly-pale" Ester 10	110	65	1360
"Pentalyn" H	105	65	1300
"Poly-pale"	101	67	1500
"Staybelite" Ester 10	80-85	>75	>1600
Perhydrogenated Rosin	80-82	>75	>1600
N-Wood Rosin	83	>75	>1600
"Resin 731D"	81	>75	>1600
"Pexite" 31	81	>75	>1600
"Staybelite"	76	>75	>1600
"Resin 861"	74	>75	>1600

*Hercules Powder Co. trade-marked products listed in this table are rosin-derived resins.
"Dymerex"—a dimerized rosin.
"Pentalyn" A—the pentaerythritol ester of rosin.
"Poly-pale" Ester 10—the glycerol ester of polymerized rosin.
"Pentalyn" H—the pentaerythritol ester of hydrogenated rosin.
"Poly-pale"—a polymerized rosin.
"Staybelite" Ester 10—the glycerol ester of hydrogenated rosin.
"Resin 731D"—a disproportionated rosin.
"Pexite" 31—a specially treated pale wood rosin.
"Staybelite"—a hydrogenated rosin.
"Resin 861"—a pale, distilled, stabilized rosin.

curred at a rate that was conveniently rapid and yet could be experimentally followed.

Aging under the effect of ultra-violet (U. V.) radiation was accomplished by means of a germicidal U. V. bulb. The aging box was vented so as to avoid build-up of ozone concentration.

Typical aging curves are shown in Figure 4 for 3:2 Pentalyn H-rubber (Pentalyn H is the pentaerythritol ester of hydrogenated rosin). In both U. V.- and heat-aging, tack was unaffected to a point, but then decreased rapidly.

Summary and Conclusions

As the tackifier concentration is increased in unvulcanized rubber in unaged films, no change in tack from that of rubber alone is observed until a tackifier concentration of 20-40% has been reached.

Based on electron-microscopic examination of the surface of a series of pressure-sensitive films by Hock and Abbott of this laboratory, the rubber appears to be saturated with tackifier at this point, and a second phase is probably formed. The amount of the second phase increases with increasing tackifier to a point and then decreases.

Presumably once the concentration of tackifier in rubber is such that the rubber is saturated, an increase in tack over that of rubber alone is obtained. The variation from resin to resin in causing an increase in tack over that of rubber alone might be explained on the basis of softening point (viscosity) and molecular asociation of resin molecules.

The harder or higher-softening resins are either more associated or are composed of larger molecules than the softer or lower-softening resins. The harder the resin the less that will dissolve in rubber because of appreciably fewer points of contact between resin and rubber. The rubber is saturated with such harder resins at lower concentrations than for softer resins. Any increase in tack, therefore, over that of rubber alone by addition of resin will occur at a lower concentration for the higher-softening resins.

Similarly, the resin concentration at which maximum tack is obtained and the maximum tack obtainable are a function of the softening point characteristics of the tackifying resin. (Table 1). Tack presumably is more responsive to the disperse or second phase (mostly) resin plus low molecular weight rubber) than to the original, continuous phase (rubber saturated with resin). Increasing the concentration of resin increases the amount of disperse phase and will result in an increase in tack only as long as some rubber continues to dissolve in this phase and the ease of deformation of this phase increases.

As discused above, the resins of lower softening point dissolve to a greater extent in rubber in the continuous phase than do the higher-softening resins. By the same token, low ends of rubber will continue to dissolve in the lower-softening resins in the disperse phase as resin concentration increases which makes the latter phase more deformable at higher resin concentrations than when harder resins are used. Therefore increasing the concentration of soft resins in the gross adhesive mass will increase the ease of deformation and the tack at much higher concentrations than will hard resins. The soft resins, moreover, will ultimately contribute more deformability and more tack than a hard resin.

At maximum tack, presumably the maximum amount of low ends of rubber has dissolved in the disperse, resin phase. Further increase in resin concentration apparently results in the disperse, resin phase increasing in brittleness, and perhaps a phase inversion occurs. In any event, the gross adhesive mass becomes considerably less viscoelastic, and tack decreases.

Assuming the necessity of a two-phase system for tack, aging in general presumably causes intrinsic changes that lead back to a one-phase system. Films aged to zero tack have been found to be one-phase. We believe that during aging the elastomer apparently decreases sufficiently in molecular weight so as to make resin and rubber completely compatible in the molecular sense, and adhesion is then no longer possible. Preliminary data indicate that adhesives aged to the point of zero tack contain rubber that has decreased nearly 75% in molecular weight and is completely alcohol-soluble.

A generalization concerning the specificity of the large rigid structure presented by rosin or modified rosin may be made for use of these materials as tackifying resins. On the basis of association between elastomer and tackifier, presumably a resin is compatible with an elastomer owing to the same association phenomena responsible for solutions. There are many esters and acids that certainly present as many points of contact between elastomer and tackifying resin as do the rosin derivatives.

The vast majority of the acids and esters, other than those that are rosin-based, however, have a tendency either to crystallize or exude. These, therefore, are not compatible with the elastomeric systems generally used in adhesives. Presumably the large rosin molecule allows many points of contact

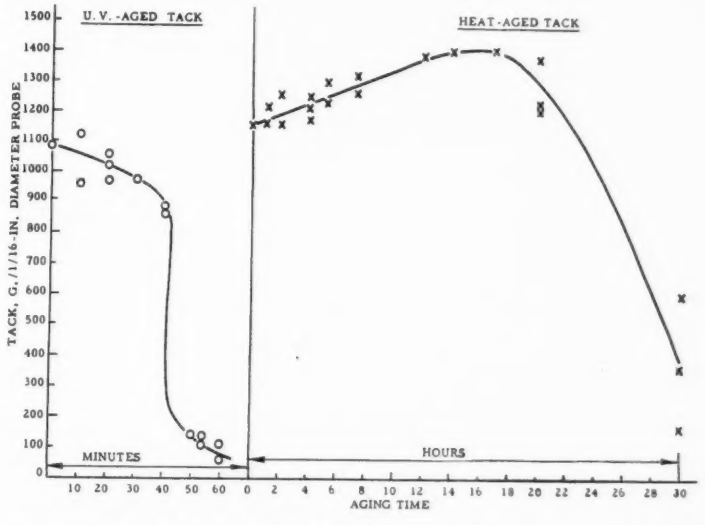


Fig. 4. Tack of 3:2 Pentalyn H-rubber as a function of accelerated aging under ultra-violet radiation and heat (200° F.)

for contributing to this compatibility between the large resin molecule and the elastomer. Moreover, the natural rosin-based tackifier will not crystallize. The molecule appears to be sufficiently large so that its lack of mobility will not lead to concentration of the tackifier in local areas and thus cause exudation.

This picture is, however, quite complex. Abietic acid, when used alone with unvulcanized rubber, crystallizes very rapidly and is useless as a tackifying resin. Dihydroabietic and dehydroabietic acids behave in the same manner. Furthermore, combinations of any two of these also crystallize. But, when all three acids are combined, the combination appears to be completely compatible with natural rubber, will not crystallize, and does indeed lend an appreciable increase in tack over that of rubber by itself. This level of tack, however, is considerably less than that found in a natural rosin, bearing, as the chief components, all three of these acids. There seems, therefore, to be a certain synergistic effect of these various structures which is necessary for compatibility and contribution to adhesion.

What other trace elements occurring in the natural product of rosin are a necessity to contribute to adhesion in an elastomeric system awaits definition.

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Questions and Answers

Q. What can be said about the compatibility of rosin and rosin derivatives with phenolic resins for use in adhesive applications in the rubber industry?

A. Rosin and rosin-derived tackifiers are compatible with the thermoplastic phenolic resins. Either rosin or rosin modified with substituted phenols and formaldehyde may be used. Such systems are used principally in neoprene adhesives, but are also compatible with phenolic resins used with natural or styrene-butadiene rubber.

Rosin and rosin derivatives are also widely used with curing phenolics. The rosin nucleus is used as such in many straight curing PF formulations such as laminates. The rosin nucleus may be modified with methylol-phenol, and these resins are also used in cured phenolic systems, e.g., laminating adhesives for punch stock.

We feel that combinations of phenolics and the rosin esters give the advantage of the high molecular weight and stability properties of the phenolics and the flexibility and tackifying ability of the rosin-ester resins.

Q. What are the capabilities and limitations of tert-butylphenol-acetylene condensation products in adhesive applications?

A. The reaction of tert-butylphenol and acetylene does not produce the expected vinyl ether, but a condensation product with phenol-formaldehyde linkages, having free phenolic groups in it. While these compounds generally are good tackifiers for SBR, they are dark in color, quite hard, may stain, and are quite expensive. Where color is not important, as with butyl rubber adhesives, these resins may find considerable use. These resins, called "Koresin," have found considerable use in Germany. Their stability is, in general, very good.

Q. A mixture of masticated crepe rubber, zinc oxide, curatives, and a rosin derivative is used in a cloth backing to produce material having building tack. The finished product which requires these materials may be formed after they are stored for six months. Can you suggest the addition of any material which might aid in slowing down or stopping the oxidation of the rubber surface, thus aiding in tack retention?

A. Use of rosin esters rather than rosin acids is advisable with zinc oxide since in the latter case zinc resinates may be formed which appreciably stiffen the adhesive mass. A degree of softness and flexibility is essential for tack, and stiffening decreases tack.

Oxidation of a rubber surface or a gross rubber adhesive will be considerably lessened if a stabilized rosin ester, such as a partially hydrogenated one, is used instead of an unmodified rosin acid or ester. Incorporation of three or four parts of lanolin will also keep the adhesive soft over a longer period of time than an adhesive without lanolin. The lanolin apparently migrates to the surface to form an extremely thin coating which prevents oxidation without decreasing useful tack.

Q. Are the polybutenes used to any great extent in adhesives and, if so, in what specific types?

A. These low molecular weight, almost liquid-like materials such as Indopol[3] and Vistac[4] are used in several different types of adhesives: (1) as plasticizers in SBR and butyl rubber pressure-sensitive adhesives to the extent of about 1-15%; (2) as tack builders in latex dispersed pressure-sensitive adhesives and certain types of latex cements, and (3) in waxy and resinous-type, hot-melt applied coatings and adhesives to the extent of 10%.

Use of butenes is rather widespread, and they are quite important in the stiffer-type elastomers such as Vistanex[5], which, with other types of isobutylene polymers, typify polybutenes in the broad sense. Isobutylene polymers find their largest use in surgical, pressure-sensitive tapes and in certain latex cements.

Q. What effect does the unsaturation of a petroleum resin, as measured by iodine number, have on the physical properties of an adhesive?

A. The answer to this question requires several sweeping generalities which may not be entirely valid. The unsaturation of a petroleum resin is of several different types, and the reaction of the various types to iodine differs with the type of unsaturation. Not only does iodine add to olefinic unsaturation, but a certain amount of substitution or hydrogen extraction also occurs. The iodine number should, therefore, be corrected for iodine lost by substitution, before the index is used as an index of olefinic unsaturation. The corrected iodine number still does not detect aromatic-type unsaturation.

A certain amount of unsaturation increases compatibility and may make the resin behave as if it were substituted, inasmuch as substitution increases compatibility. The presence of unsaturation may also decrease the tendency of a compound to crystallize. Therefore, to a point, the greater the amount of unsaturation, the more compatible will be the resin with an elastomer in an adhesives application. Beyond this point, the effect of unsaturation is probably overshadowed by the effect of overall structure and substituents.

Any correlation between iodine number and susceptibility to oxidation of a compound is, in my opinion, doubtful. Oxidation is generally thought to be primarily on the position adjacent to the olefinic unsaturation *and* positions adjacent to aromatic rings. Though the iodine number may detect olefinic unsaturation, it reflects nothing of the adjacent groups. Moreover, the subsequent effect of oxidation of tackifying resins on the adhesive mass varies from elastomer to elastomer. SBR usually cross-links; whereas natural rubber degrades.

Q. What methods are known for promoting autohesion, cohesion of rubber?

A. As far as most rubber-based adhesives of the non-curing type are con-

[3] Standard Oil Co. of Indiana, Chicago, Ill.

[4] Advance Solvents & Chemical Division, Carlisle Chemical Works, Inc., New York, N. Y.

[5] Enjay Co., Inc., New York, N. Y.

cerned, you can't "have your cake and eat it too." As adhesion is increased by the addition of tackifiers, as, perhaps, plasticizers, cohesion decreases. You must decide what service you are designing the adhesive for and how much you are willing to sacrifice in cohesion to increase the adhesion.

Latex Tire-Cord Adhesives

E. Leonard Borg

Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn.

TIRE cord is solution treated with rubber and other materials for two reasons. First, the adhesive deposited on the cords from the solution acts as a tie coat to strengthen the bond between the cord and the carcass rubber, which results in a stronger tire less likely to develop ply separation. Second, the adhesive serves to keep the cords separated in the weftless fabrics used in carcass construction, which prevents chafing and reduces cord abrasion and failure.

History

The first tire-cord adhesives were solvent rubber cements. These were applied to the square-woven cotton fabrics then used in tire carcass by a process of dipping followed by solvent removal. This procedure was thought to be an improvement over the friction calendering process and was used for some time as an alternate to that older mechanical method. An aqueous process for tire-cord solutioning was first mentioned in 1921. The patents disclosed the use of a bath of normal *Hevea* latex through which the carcass fabric was passed, to be followed by squeezing between rolls and drying. These features of the aqueous dipping process remain unchanged today.

In the years prior to World War II the aqueous process for solutioning of tire carcass fabrics was universally adopted. During those same years the weft in the fabrics was first reduced and then eliminated. This change answered the demand for a carcass with fewer yarn-to-yarn contacts where chafing, with consequent heat build-up and possible failure, could occur. The fiber during this prewar period was cotton; the carcass and tread stocks were natural rubber; and the dip bath was *Hevea* latex.

Casein and reclaimed rubber dispersions as extenders came into use at this time. Casein was felt by some to contribute to adhesion, and it also stabilized the viscosity of the dip bath. The percentage of reclaim dispersion in the *Hevea* latex bath could be quite high without adversely affecting adhesion, and this fact was of considerable economic importance to the tire manufacturers.

Rayon Cord

After World War II much of the *Hevea* rubber used in passenger tires was replaced by SBR. This change, along with increased vehicle speeds on postwar highways, forced an improvement in carcass construction. Cotton loses much of its strength at the high temperatures developed in SBR tires, and failures resulted. Rayon not only has greater green strength than cotton, but its strength is less temperature dependent. Thinner, cooler running tires could be built on a rayon carcass, and this man-made fiber was soon widely adopted for tire carcass construction. The solutioning of tire cord, rather a simple process when applied to cotton, was greatly complicated by the substitution of rayon.

Cotton fiber, when examined under the microscope, is found to be convoluted and somewhat fuzzy. On such a surface the tire-cord adhesive has something to hang onto, and the development of the desired bond to the carcass rubber is not a particular problem. Indeed, aqueous solutioning of cotton cords was not considered essential, and the mechanical calendering treatment was felt to be an adequate alternate procedure. By either method the total adhesive strength of the fuzzy fiber ends buried in the cured rubber stock was greater than the tensile strength of the cotton cord itself.

Rayon presents a different problem. Here the fiber, a monofilament, is smooth, straight, and lacking the convenient "handles" found on cotton. These factors combine to make a difficult problem of developing a total adhesive bond between a rayon cord and the carcass rubber which is greater than the ultimate tensile strength of the cord itself. The *Hevea* latex, reclaim dispersion, casein cord dip solutions, satisfactory on cotton cords, do not do an adequate job on rayon.

Pyridine Latex

Since there are no convenient "handles" on the rayon fiber, such as are found on cotton, a logical approach was to build these "handles" into the adhesive. Natural rubber and SBR are non-polar materials, and their function as adhesives to natural or regenerated cellulose is solely mechanical. By introducing polarity into the adhesives the mechanical forces of adhesion can be supplemented by the strong dipole bonds established among the carbohydrate, cellulose, and a polar material. The polar "handle" which was found to be effective is pyridine, a simple heterocyclic, nitrogen containing, chemical constituent of coal tar.

Pyridine, in the form of vinyl pyridine, is copolymerized with butadiene and styrene to yield a rubbery terpolymer containing a substantial number of the important, polar pyridine groups. The terpolymer is supplied as a latex for use as an ingredient in the cord dip.

Resorcinol Formaldehyde

Another chemical "handle" which enhances the adhesion of rayon cord to the carcass rubber is resorcinol-formaldehyde resin. This resin is thought to link chemically to the hydroxyl groups in the regenerated cellulose, with the consequent development of adhesion far greater than could be obtained from mechanical forces alone.

Nylon Cord

Recently we have seen a trend toward the use of nylon in tire cord, which further complicates the adhesion problem and for the same reasons already mentioned in the case of rayon. To obtain an adhesive bond between nylon and the carcass rubber which is stronger than the nylon itself is even more difficult than in the case of rayon. The same polar groups which were found to be effective in strengthening the adhesive bond to cellulose are used to promote adhesion to nylon, itself a polar polymer. Vinyl pyridine latices used in rayon-cord dips are also used for nylon.

Cord Dipping Process

The methods of solutioning tire cords and the compositions of the dip baths vary widely among different tire builders. The essential features of a dip tank, followed by squeeze rolls and a dryer, are common to all installations today, as they have been for many years. Generally, the cords are taken off a multiplicity of cones or creels and gathered into a parallel arrangement with controlled lateral spacing before passing through the dip.

In the case of nylon cords, prestretching may also be done at this time. The dryer may operate on circulated heated air, hot cans, or a combination of both. The dried, treated cord is sometimes rolled up on a beam for subsequent calendering and cutting, or it may be calendered immediately at the dry end of the solutioning unit.

Dip Tank Solution

The composition of the dip bath is largely a matter of individual preference and practice. For cotton cord a mixture of SBR latex and casein in about a 6:1 ratio is common. If resorcinol-formaldehyde resin is used, it will comprise 10 to 15% of the total bath solids. The SBR latex is likely to be either the hot 2000 or the cold X-765 type. A rayon dip is about the

same as one for cotton except that 20% of the SBR latex is replaced by vinyl pyridine latex. For dipping nylon the casein is eliminated and the SBR is greatly reduced or eliminated. The solution then consists essentially of an 85/15 mixture of vinyl pyridine latex and resorcinol-formaldehyde resin.

The bath strength in most cases is about 15 to 20% total solids. Squeeze-roll pressure is adjusted to give about 100% wet pick-up of solution on the cords. No curatives are used in the dip. The curing of the adhesive on the cords is dependent on the migration of curatives from the adjacent carcass rubber during the curing of the tire. Vinyl pyridine polymers are very fast curing and are particularly responsive to this migratory curing.

Measuring the Adhesive Bond

As has been mentioned earlier, the objective of tire cord solutioning is to develop an adhesive bond between the cord and the carcass rubber which is stronger than the ultimate tensile of the cord itself. Many laboratory tests have been devised for measuring this property. In the familiar static "H" test the force necessary to pull a single cord out of a cured slab of rubber is measured. Several dynamic tests have been devised, some of which include an exposure to high temperatures simulating service conditions. In some of these the adhesion of a single cord is measured, as with the "H" test; while in others the test specimen, which closely resembles a section of carcass, is examined for ply separation at the end of the test. A more advanced test involves the severe conditions of running an actual tire at high speed on a cleated, indoor wheel and then examining the cut-up tire for failure.

Questions and Answers

Q. Does the standard Gentac[1] RF treatment give satisfactory adhesion to nylon and Dacron cord for tires and industrial products such as hose and belting? If not, why not; and what can be done to improve this situation?

A. I cannot answer part of the question since we have done no work with Gentac in our laboratories. The standard Pyratex[2] nylon-cord dip treatment does give satisfactory adhesion. Gentac and Pyratex are reported to be very similar in composition.

I have had no experience with the use of Dacron for either tire cord or mechanical goods. Although we now consider the adhesive bond to nylon in tire carcass construction from the vinyl pyridine-RF treatment to be adequate, we are looking for improvements. The nature of these improvements will probably take the form of the selection of better and more effective chemical "handles" of the type mentioned in my paper.

Q. Can you write the equation for the reaction between resorcinol-formaldehyde and nylon?

A. I don't think there is a chemical reaction between RF and nylon, but there is one between RF and cellulose. This latter equation involves incorporation of the RF into the reaction product of the cellulose, making use of the hydroxyl groups in the cellulose fiber.

Q. Have dynamic adhesion tests for tire cords been developed which predict with any accuracy the resistance to the ply separation the tire encounters in service?

A. There are several dynamic adhesion tests for measuring the effectiveness of the adhesive bond between carcass rubber and tire cord. In the so-called Henley test, developed in England, the cord is cured into a slab of carcass rubber and is held in tension to simulate the conditions in an inflated tire while the rubber is rapidly flexed to build up heat. Periodically, the flexing is interrupted, and the force necessary to pull the cord from the carcass slab is measured. This test is reported by its developers to predict accurately the performance of tires in service.

Another test involves the construction of a section of carcass in the form of a strap which is then rapidly passed over a roller to build up heat in the sample. Again the test is interrupted periodically, and the strap examined for signs of failure. The end-point in this test is in terms of cycles to failure.

In still another test a carcass construction is built into the form of a truncated cone mounted on a machine and flexed rapidly at variable amplitude and frequency. The end-point of this test is also in terms of cycles to failure, and the test includes a post-mortem examination of the carcass for signs of internal failure.

In the final analysis, however, I doubt if any tire builder would make a major change in carcass construction or cord dip practice without actually going through a tire test. I mentioned that tire tests can be done indoors on a cleated wheel in 72 hours. But the payoff is on the road; any major change in carcass construction should be road tested before adoption.

Q. How good are the present tire-cord dips for nylon tire cord? Is there any urgency with respect to the development of improved dips for nylon?

A. As mentioned previously, the present tire-cord dips for nylon based on vinyl pyridine latex-RF resin are quite adequate. This statement does not mean, however, that there isn't a sense of urgency of the same magnitude as that which impels us to try to improve everything we make.

The ultimate objective of any adhesive for tire cord is to produce a bond as strong as the tensile strength of the fiber. There is no point to having the adhesive bond stronger than that of the fiber because the fiber breaks first. The function of the adhesive is to anchor the fiber in the carcass to the extent that when a break occurs, it will be the fiber.

Q. Are latex dips considered superior to rubber solution for cord dips; if so, why?

A. Latex dips are considerably better than rubber solutions for cord dips, but the reasons are a little obscure. With a rubber or adhesive solution, much of the effective solids is lost into the structure of the cords; whereas in the case of the latex dip the bundle of fibers which make up the cord function as a semi-permeable membrane to filter out the adhesive solids on the surface where they do the job of bonding the cord to the carcass rubber.

Q. What methods are known for promoting autohesion, cohesion of rubber?

A. Assuming that autohesion and cohesion are synonyms, in an adhesive system two forces are at work, the adhesive forces of the mass to the surface and the cohesive forces within the adhesive mass itself. The problem of increasing the cohesive forces is one of molecular engineering.

If a polymeric material is the base of the adhesive mass, the polymer can be selected to develop more or less cohesive force, because as the molecular weight of the polymer increases, the cohesive forces will be greater. Also, as branching in the polymer increases, the cohesive forces will be greater, and a polymer which crystallizes upon stretching will develop very strong cohesive forces.

(To be continued)

[1] General Tire & Rubber Co., Akron, O.
[2] Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn.

Tire Ride Meter

Esso Research & Engineering Co., New York, N. Y., had developed a ride meter to evaluate characteristics of tires under high and low temperatures and various ranges of inflation, and to determine what parts of tires contribute to smooth riding, and why. A key part of the equipment is a tiny vibration detector, weighing one ounce and having a diameter less than that of a dime. The device registers the slightest jounce felt by the tire and transmits a signal to apparatus mounted on a platform inside the car. This signal, modified by electronic circuits, is traced on graph paper. Interpretation of this information reveals comfort level felt while riding.

Newton Group Speaker

The second meeting of the 1957-58 season of the Fort Wayne Rubber & Plastics Group was held in the Van Orman Hotel, Fort Wayne, Ind., on December 5 and was attended by 244.

The oyster bar was available through the courtesy of O'Connor & Co., Chicago, Ill. A three-course dinner of filet mignon and trimmings was enjoyed.

The Group announced 340 paid members at that date.

E. B. Newton, B. F. Goodrich Chemical Co., Research Center, gave a lecture on "Synthetic Natural Rubber." He used slides to illustrate his talk. A summary of his speech follows.

In 1826, Thomas Hancock, who founded the modern rubber industry in England, as Charles Goodyear did in America, supplied a tube of uncoagulated Castilloa latex to Michael Faraday for analysis. Faraday showed that the principal constituent is a hydrocarbon of the empirical composition, C_5H_8. Greville Williams in 1860 was able to isolate a liquid hydrocarbon of this same composition by the destructive distillation of rubber. He called it isoprene and suggested that it was related to rubber as monomer to polymer.

G. Bouchardat in 1870 definitely proposed that isoprene was the "mother" substance of rubber and on treating isoprene with hydrochloric acid obtained a weak elastic solid. This was the first rubber synthesis.

William Tilden in 1884 obtained isoprene from a source other than rubber—by cracking turpentine—and reported its polymerization. In 1910, Mathews and Strange discovered that metallic sodium would polymerize isoprene. These early rubbers lacked the building tack, good milling characteristics, and high strength of natural rubber vulcanizates, but the reasons for these drawbacks were not clearly understood.

About this time, however, C. O. Weber and Samuel Pickles proposed that natural rubber was probably a linear polymer of isoprene unit, and in 1925, J. R. Katz, using X-ray diffraction technique, showed the regularity of structure in the polymer chain.

Despite these great advances in understanding the structure of the natural rubber polymer chain, the first commercially successful diene rubber was not a polyisoprene, but a polychloroprene, Duprene, later called neoprene, introduced in 1931.

It was a little more than three years ago that the first polyisoprene essentially duplicating the natural rubber polymer was announced. This was made with a Ziegler-type catalyst. Since then, two other successful catalyst systems have been announced; one uses metallic lithium, the other uses lithium alkyl. The first two catalysts appear to be of the heterogeneous type; the latter, homogeneous.

The polyisoprenes made in each of these three systems are for practical purposes like natural rubber. They show building tack, good milling properties, high strength, and low heat build-up in gum as well as carbon black vulcanizates. They show X-ray diffraction patterns and infrared spectra essentially identical with those of *Hevea* rubber. Polyisoprene made with the Ziegler-type catalyst and that made with metallic lithium catalyst have been produced in large-scale pilot-plant quantities, permitting factory processing runs. Bus tires made entirely of these synthetic cis-1,4 polyisoprenes have performed in service as well as the *Hevea* rubber control tires.

It was announced that the next meeting of the Fort Wayne Group will be held on February 13 at the Van Orman Hotel.

Akron RG Plans Course

Fifteen technical lecture-discussion meetings on rubber compounding are being offered by the Department of Chemistry, University of Akron, and the Akron Rubber Group, Akron, O., during early 1958. The lectures, which began January 13, are given from 8:30 to 10:30 p.m.

The lectures and lecturers are as follow: January 13, "Introduction to Lecture Series," C. E. Carlson, The General Tire & Rubber Co., and "Chemistry and Physics of Polymers," Part I, Maurice Morton, Akron U; January 20, "Chemistry and Physics of Polymers, Part II," Dr. Morton; January 27, "Carbon Blacks—Their Application in Rubber Compounding," J. Gifford, Witco Chemical Co.; February 3, "Non-Black Pigments," V. Vodra, Wooster Rubber Co.; February 10, "Curing Systems," D. E. Baker, Monsanto Chemical Co.; February 17, "Antioxidants, Antiozonants, and Waxes," E. L. Stangor, E. I. du Pont de Nemours & Co., Inc.; February 24, "Rubber Manufacturing Equipment," H. A. Gallagher and C. R. Washburn, Goodyear Tire & Rubber Co.; March 3, "Factory Processing," R. Schild, Seiberling Rubber Co.; March 10, "Compounding to Service Specifications," J. Hostetler, General Tire; March 17, "Practical Problems—Metal Adhesives and Cements." P. Larson, Lord Mfg. Co.; March 24, "Practical Problems—Sponge Products," C. Yoran, Brown Rubber Co.; March 31, "Practical Problems—Tires and Related Products," A. S. Miller, Firestone Tire & Rubber Co.; April 14, "Practical Problems—Hose and Belting," R. Green and T. Rodda, The B. F. Goodrich Co.; April 21, "Practical Problems—General Molded and Extruded Products," J. Brothers, Ohio Rubber Co.; and April 28, "Plant Trip—Wooster Rubber Co.," V. Vodra.

Tlargi 1958 Officers

The Los Angeles Rubber group, Inc., held its annual Christmas party at the Hilton-Statler Hotel, Los Angeles, Calif., December 13. Arrangements for this party were made by Charles H. Kuhn, Master Processing Corp., as vice chairman of Tlargi for 1957.

Some 600 members and guests and their wives were in attendance at this function. Dancing was enjoyed during the evening, and the floor show was considered to be one of the best that Tlargi has yet enjoyed.

Officers for the year 1958 were introduced by Carl S. Hoglund, chairman of the nominating committee. These officers follow: chairman, A. H. Federico, C. P. Hall Co.; associate chairman, Mr. Kuhn; vice chairman, B. R. Snyder, R. T. Vanderbilt Co.; treasurer, W. M. Anderson, Gross Mfg. Co.; secretary, L. W. Chaffee, Ohio Rubber Co.; directors, C. M. Churchill, Naugatuck Chemical Division, United States Rubber Co.; W. E. Boswell, Thiokol Chemical Corp.; C. E. Huxley, Enjay Co.; H. R. Fisher, W. J. Voit Rubber Corp.; W. J. Haney, Kirkhill Rubber Co.; J. L. Ryan, Shell Chemical Corp.; and R. N. Phelan, Atlas Sponge Rubber Co.

By a change in the by-laws approved at the November meeting of Tlargi the dues are now $10 per year and the initiation fee is $10. At the same time the change in the by-laws also called for increasing the board of directors from nine members to 12 in order to handle more efficiently the greatly expanded work of the group.

Raymond E. Bitter was appointed as a three-year member of the Tlargi Rubber Technology Foundation Board from Tlargi.

ACCCE Symposium

The Association of Consulting Chemists & Chemical Engineers, Inc., has announced a symposium, "New Techniques for Research," pertaining to the basic principles involved in the choice of instrumentation for chemical investigations, to be held March 5, 5:00 p.m., at the Hotel Shelburne, Skyline Room, New York, N. Y.

Moderated by E. G. McDonough, executive vice president, Evans Research & Development Corp., the symposium will feature guest speaker Seymour Z. Lewin, associate professor, New York University.

Cocktails and banquet will precede the symposium which is an open, informal meeting. Reservations accompanied by check for $10.00 per person must be received by the Association not later than March 3, on company letterheads. Address: ACC & CE Inc., Rm. 82, 50 E. 41st St., New York 17.

Washington Group Hears Sackett

The Washington Rubber Group held a dinner-meeting, preceded by a cocktail hour, at the Naval Gun Factory Officers' Club, Washington, D. C. on January 15.

At the business session President Douglas Bonn announced the decennial celebration meeting to be held at the National Press Club, Washington, D. C., on February 18. The guest speaker at the banquet will be H. E. Humphreys, Jr., chairman of the board, United States Rubber Co.; at the technical session the speakers will be Allen V. Astin, director of National Bureau of Standards, and Raymond P. Dinsmore, vice president, research and development, Goodyear Tire & Rubber Co., Akron, O.

During the January 15 meeting George A. Sackett, director of repair material, Armstrong Rubber Co., spoke on "The Care and Repair of Tubeless Tires." He reported that most of the troubles with tubeless tires can be removed by properly instructing retreaders, garage men, and service station men, thereby eliminating some of the misapprehensions which many of them have regarding the tubeless tires.

One of the major problems with tubeless tires is separation, and it seems to predominate in the central and southwestern areas of the country where high speeds and long continuous driving are prevalent. It is indicated that tire heat developed after long driving periods at high speeds is probably the major cause. Since driving habits cannot be changed, other means must be found to overcome this trouble, which is also reported to be affecting tubed-type tires as well.

Sackett recommended a dual program of educating the public as well as retreaders, garage men, and service station men. The public will be educated to have periodic inspection of its tires through a program planned by The Rubber Manufacturers Association, Inc. For example, sharp objects lodged in the tread should be removed before they cause trouble.

Garage and service station operators should be taught the operating advantages of tubeless tires as well as the methods of inspection of tires and rims, and the proper technique for making simple repairs with plugs and patches, it was said. Emphasis should be placed on doing good careful repairs, instead of trying to sell the motorist on putting a tube in a tubeless tire. Retreaders should be educated in inspection, thorough preparation of a tire, venting technique, and the sound methods of repair before retreading is done.

A comprehensive demonstration of the tools and equipment for making repairs with plugs and patches was given by Sackett. A thorough educational program is hoped to result in better repairing and retreading service and a better public acceptance of the tubeless tire.

Analysis Topic of Northeastern Section Meeting

The third meeting of the current season was held on January 15 at Science Park, Charles River Dam, Boston, Mass., and consisted of a dinner, attended by 115 members and guests of the Elastomer & Plastics and the Analytical groups of the Northeastern Section, ACS, and a technical session that followed.

This session, opened by Max Taitel, UBS Chemical Co., chairman of the Elastomer & Plastics Group, consisted of a symposium on "The Analysis of Elastomers," arranged by David Hume, MIT., and Frank J. O'Halloran, Water Laboratory, State of Massachusetts. Speakers were Avrom I. Medalia, Godfrey L. Cabot Co., Inc., who discussed "Solubility of Polymers," and Richard C. Lord, Jr., MIT, who dealt with "The Use of Infrared in the Elastomer and Plastic Field."

Dr. Medalia discussed the theory of mixing of two gases as a basis for his discussion of polymer solution and mixing and considered the relations of polymer and solvent molecules, and chain lengths, to solubility. He spoke about the importance of critical miscibility temperature and the use of cohesive energy density in predicting the solubility of polymers in solvents.

Continuing, Dr. Medalia dealt with the rubbery, glassy, and crystalline states of polymers, and the influence of hydrogen bonding on the solubility of crystalline polymers in particular. He then discussed isotactic polymers and explained their increased solubility in terms of their more coil-like structure. He concluded his talk by considering cross-linked molecules when exposed to solvents.

Dr. Lord outlined the structure and operation of the spectrometer used in ultra-violet analysis and showed slides of the electromagnetic spectrum, and of a popular model of spectrometer and showed samples of specimens ¼-mil to three mils thick, while indicating the preparative methods for powders and soluble materials prior to irradiation.

He also showed special fixtures, such as used for polarized analysis where vibrational directions are to be determined for parts of materials being analyzed.

For the main portion of his talk Dr. Lord showed slides of various polymer spectra and discussed the features of each that permitted the determination of the structural characteristics of each. Included were spectra for polyethylene terephthalate, PVC, epoxy resins, Nylon 6, silicone rubber, Teflon, polystyrene, polyethylene, polymethylmethacrylate, vinyl chloride-vinyl acetate copolymer, and natural and synthetic rubbers. Questions followed the talks. There were 125 present at the technical session.

Boston RG Course

A course in Rubber Technology II will be given Monday evenings, beginning February 3, 7:00-9:00 p.m., by Northeastern University in cooperation with the Boston Rubber Group, Boston, Mass. The course, a study of the principles and practices of rubber technology, will present the relation of polymer structure to properties and how these structural characteristics can be used to advantage by the rubber compounder. Five major problems in areas of rubber manufacture will be presented by guest lecturers. The course will be technical in content, and as a prerequisite applicants should have either completed the Rubber Technology I course or have a B.S. in chemistry.

The instructor will be Charles B. Griffis, chief, rubber technology section, QM R & E Command, Natick, Mass. For the past 10 years he has been an active participant in the Army-wide rubber research program.

The course, consisting of 15 lectures, will be given at Northeastern University, Room 300, Richards Hall, Boston. The cost is $40.00 per student, including registration fee. Tuition may be budgeted. Since the class is limited, only the first 50 applicants can be accepted.

1958 Nuclear Congress

The atomic energy industry of the United States will demonstrate its progress in the uses of nuclear energy for the benefit of the Western World during the 1958 Nuclear Congress, March 17-21, at the International Amphitheater, Chicago, Ill.

The four major elements of the 1958 Congress and the area each covers are:

The Nuclear Engineering and Science Conference, on behalf of more than 30 participating engineering and scientific societies, will present 150 technical papers on late developments in the several fields of atomic energy applications, including a number of papers on aircraft propulsion.

The Atomic Industrial Forum, Inc.,

Atomfair, will be held in conjunction with the technical sessions of the Congress and will feature the latest developments in industrial uses of atomic energy. Registration for the Atomfair is open to Congress delegates and to science-minded people in industry.

Atomic Energy Management Conference, sponsored jointly by the National Industrial Conference Board and the Atomic Industrial Forum, Inc., will provide management with a comprehensive review of progress made to develop low-cost nuclear power and other industrial uses of atomic energy.

The Sixth Hot Laboratories and Equipment Conference, sponsored by the Hot Laboratories Committee of the Oak Ridge National Laboratories, will deal with the highly technical details of the development of equipment and the operation of laboratories for atomic energy.

Attendance at the 1958 Congress is expected to exceed that of the 1957 Congress in Philadelphia when 16,000 participated, including 3,000 at the technical meetings.

For further information in New York, write Joel Henry, American Institute of Chemical Engineers, 25 W. 45th St., New York 38, N. Y. In Chicago, write J. Earl Harrington, Western Society of Engineers, 84 E. Randolph St., Chicago, Ill.

AIEE Conference

The American Institute of Electrical Engineers Rubber & Plastics Industries Subcommittee of the General Industry Applications Committee will hold a two-day Conference on Electrical Engineering Problems in the Rubber and Plastics Industries in Akron, O., at the Mayflower Hotel, April 14-15.

A tentative program consists of the following lectures and speakers: Opening Keynote Address, R. A. Jay, Goodyear Tire & Rubber Co.; "A Static-Magnetic Adjustable Speed Motor Controller," D. A. Baker, Cutler-Hammer, Inc.; "Precision Speed Matching for Calender and Train Drives," P. R. Gravenstreter and W. A. Shelton, Clark Controller Co.; "Automatic Bulk Conveying of Plastic Materials with Air," A. D. Bloomberg, Monsanto Chemical Co.; "Tread Conveyor System," L. Willmott, Willmott Electric Co.; Banquet Address—"Soviet Higher Education—Threat or Promise," N. P. Auburn, president, University of Akron; "Electronic Weighing in Material Handling Applications," V. C. Kennedy, Jr., Streeter-Amet Co.; "An Automated Warehousing Installation," R. N. Johnson, W. F. & John Barnes Co.; "Aids in Trouble Shooting," J. Sutton, The B. F. Goodrich Co.; and two subcommittee reports, "Problems Due to Atmospheric Contamination," N. A. Williams, Goodyear, and "Standardization for Rubber and Plastics Industries," W. S. Watkins, Ohio Rubber Co.

Additional information may be obtained from the AIEE, 33 W. 39th St., New York 18, N. Y.

ASTM Assigns SBR Number

Committee D-11 on Rubber and Rubber-Like Materials of the American Society for Testing Materials through Subcommittee 13 on Synthetic Elastomers has assigned a number to a styrene-butadiene rubber (SBR) which is manufactured by Phillips Petroleum Co., Bartlesville, Okla. This procedure is in accordance with that established by Subcommittee 13 of D-11 and agreed to by the Committee, the Society, and the private producers of SBR and SBR latices.[1] This new rubber will also be included in the letter-ballot now being processed in order to bring D 1419-56T up to date.

DESCRIPTION OF TYPES OF SBR RUBBERS—ASSIGNMENT OF NEW CODE NUMBERS—ASTM D 1419-56T

Number assigned	1805
Date assigned	12/18/57
Requested by	Phillips Petroleum Co.
Distinctive feature	Antioxidant NST; high naphthenic oil and high HAF black
Close previous number, if any	Philprene 6600
Type	1805
Nominal temp., °F.	43
Activator	FRA
Shortstop	ND
Antioxidant	NST
Catalyst	OHP
Emulsifier	mixed
Nominal bound styrene, %	23.5
Conversion, %	60
Mooney viscosity, ML, 1+4, 212° F., polymer	——
Compound	58
Coagulation	SA
Carbon black type	HAF
%	35.3
Oil type	NAPH
Parts	37.5
Finishing	normal

Note: Abbreviations and symbols are defined as follows:
FRA = free radical type, i.e., iron-pyrophosphate peroxamine sulfoxylate
ND = Non-discoloring
NST = Non-staining
OHB = Organic hydroperoxide
SA = Salt-acid

[1] RUBBER WORLD, Aug., 1957, p. 718.

Materials Handling Conference Scheduled

A national conference on materials handling, the first to be sponsored by the American Society of Mechanical Engineers since 1949, will be held in conjunction with the National Materials Handling Exposition, produced by Clapp & Poliak, Inc., exposition management firm, at the Public Auditorium, Cleveland, O., June 9 to 12.

This move is in accordance with the Society's policy of encouraging its professional divisions to sponsor separate national conferences devoted to serving mechanical engineers in the specialties of their particular fields.

The National Materials Handling Exposition will have one of the largest and most varied displays ever gathered of materials handling equipment. The conference was chosen to be held concurrently because the exhibits will provide an important practical background to the scientific discussions.

It was reported that materials handling is the background of automation. Progress toward the goal of the automatic factory will be slow unless a true science of moving materials is developed. This means reliance, not on one type of equipment, but on a system which uses the most appropriate equipment for the specific need.

Design Engineering Show

The annual Design Engineering Show, an exposition devoted to products which, as component parts, go into the making of end-products, will be held in Chicago, Ill., for the first time, it has been announced by Clapp & Poliak, Inc., the exposition management firm which produces the event.

The show will take place at the International Amphitheatre, April 14 to 17. The show was first held in Philadelphia in 1956 and in New York in 1957. Some idea of its importance to the industrial field may be gathered from the fact that it has grown in this short period to a point where it is now the third largest annual industrial exposition in the country.

Supplementing the exhibit will be a four-day Design Engineering Conference, sponsored by the machine design division of the American Society of Mechanical Engineers, at the Amphitheatre during the same period.

The show's growth is reflected in the number of companies participating and the exhibit area used. There were 175 exhibitors in 1956; 371 in 1957, and 410 will participate in 1958. Exhibit area in 1956 was 37,000 square feet; 80,000 in 1957; and 125,000 will be used in 1958.

Among products to be shown will be mechanical components, power transmission equipment, electrical and electronic components, metals, non-metallic materials, fasteners and adhesives, finishes and coatings, shapes and forms, hydraulic and pneumatic components, and engineering equipment and services.

Registration forms, program and hotel information may be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

CALENDAR of COMING EVENTS

February 18
Washington Rubber Group. Decennial Meeting. National Press Club, Washington, D. C.

Elastomer & Plastics Group, Northeastern Section, ACS. Museum of Science, Boston, Mass.

February 21
Connecticut Rubber Group. Monero's Restaurant, Orange, Conn.

February 21-22
Southern Rubber Group. Shamrock Hotel, Houston, Tex.

March 4
The Los Angeles Rubber Group, Inc. Biltmore Hotel, Los Angeles, Calif.

Buffalo Rubber Group. Spring Meeting. Hotel Westbrook, Buffalo, N. Y.

March 5
Association of Consulting Chemists & Chemical Engineers, Inc. Symposium —"New Techniques for Research." Hotel Shelburne, New York, N. Y.

March 11
Ontario Rubber Group, CIC. Royal Hotel, Guelph, Ont., Canada.

March 14
Chicago Rubber Group.

March 17-21
1958 Nuclear Congress. International Amphitheatre, Chicago, Ill.

March 18-21
Committee D-13, American Society of Testing Materials. Spring Meeting. Sheraton-Park Hotel, Washington, D. C.

March 27
Commercial Chemical Development Association. Annual Meeting—"The Commercial Impact of Synthetic Rubber." Hotel Statler, New York, N. Y.

March 27-29
Division of High-Polymer Physics, American Physical Society. Eighteenth Meeting. University of Chicago, Chicago, Ill.

March 28
New York Rubber Group. Henry Hudson Hotel, New York, N. Y.

April 1
The Los Angeles Rubber Group, Inc. Biltmore Hotel, Los Angeles, Calif.

April 10
Fort Wayne Rubber & Plastics Group. Van Orman Hotel, Fort Wayne, Ind.

April 10-11
American Institute of Chemists. Annual Meeting. Ambassador Hotel, Los Angeles, Calif.

April 11
Akron Rubber Group. Spring Meeting.

April 13-18
American Chemical Society. National Meeting. San Francisco, Calif.

April 14-15
American Institute of Electrical Engineers, Rubber & Plastics Sub-Committee of the General Industry Applications Committee. Ninth Conference on Electrical Engineering Problems in the Rubber and Plastics Industries. Sheraton-Mayflower Hotel, Akron, O.

April 14-17
Design Engineering Show and Conference. International Amphitheatre, Chicago, Ill.

April 16
Washington Rubber Group.

April 20-23
American Institute of Chemical Engineers and The Chemical Institute of Canada. Chemical Engineering Conference. Montreal, P.Q., Canada.

April 25
Philadelphia Rubber Group. Poor Richard Club, Philadelphia, Pa.

Chicago Rubber Group.

May 6
The Los Angeles Rubber Group, Inc. Biltmore Hotel, Los Angeles, Calif.

May 9
Buffalo Rubber Group and Ontario Rubber Section, CIC. Joint International Meeting. Hotel Sheraton Brock, Niagara Falls, Ont., Canada.

May 12-14
Eighth Canadian High Polymer Forum. National Research Council of Canada and Chemical Institute of Canada. MacDonald College, Quebec, P.Q., Canada.

May 13-16
Division of Rubber Chemistry, American Chemical Society. Netherlands-Plaza Hotel, Cincinnati, O.

May 21
Washington Rubber Group.

May 28
Division of Rubber Chemistry, Chemical Institute of Canada. Convention. Royal York Hotel, Toronto, Ont., Canada.

June 5
New York Rubber Group. Outing. Doerr's Grove, Milburn, N. J.

June 6
Fort Wayne Rubber & Plastics Group. Summer Outing.

June 9-12
ASME. National Conference on Materials Handling. Public Auditorium, Cleveland, O.

June 10
Buffalo Rubber Group. Golf Outing. Lancaster Country Club.

July 25
Chicago Rubber Group. Golf Outing. Medinah Country Club, Medinah, Ill.

August 5
New York Rubber Group. Golf Tournament. Wingfoot Country Club, Mamaroneck, N. Y.

August 22
Philadelphia Rubber Group. Golf Outing.

September 7-12
American Chemical Society. Chicago, Ill.

September 9-12
Division of Rubber Chemistry, ACS. Hotel Sherman, Chicago, Ill.

September 25
Fort Wayne Rubber & Plastics Group. Van Orman Hotel, Fort Wayne, Ind.

October 7
The Los Angeles Rubber Group, Inc. Biltmore Hotel, Los Angeles, Calif.

October 14
Buffalo Rubber Group. Fall Meeting. Hotel Westbrook, Buffalo, N. Y.

October 17
New York Rubber Group. Henry Hudson Hotel, New York, N. Y.

October 17-18
Southern Rubber Group. Roosevelt Hotel, New Orleans, La.

October 24
Philadelphia Rubber Group. Poor Richard Club, Philadelphia, Pa.

November 14
Philadelphia Rubber Group Dance.

November 17-21
Eighth National Plastics Exposition. Society of the Plastics Industry. International Amphitheatre, Chicago, Ill.

National Plastics Conference. Hotel Morrison, Chicago.

December 2
Buffalo Rubber Group. Christmas Party.

December 4
Fort Wayne Rubber & Plastics Group. Van Orman Hotel, Fort Wayne, Ind.

December 12
New York Rubber Group. Christmas Party. Henry Hudson Hotel, New York, N. Y.

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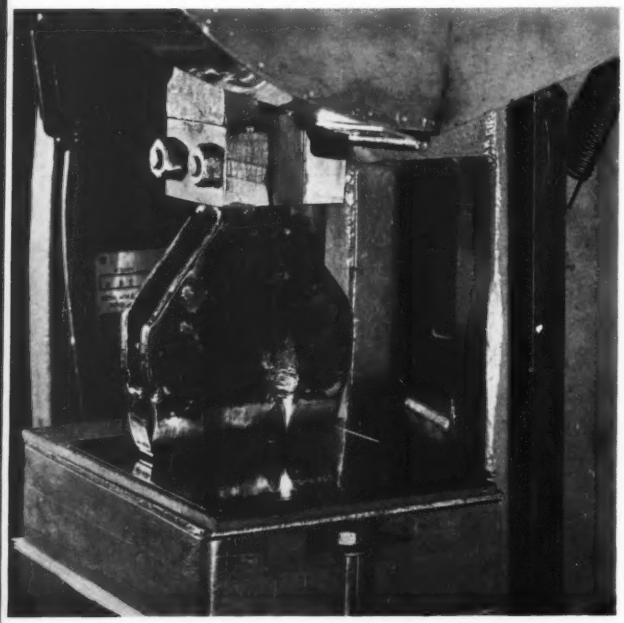

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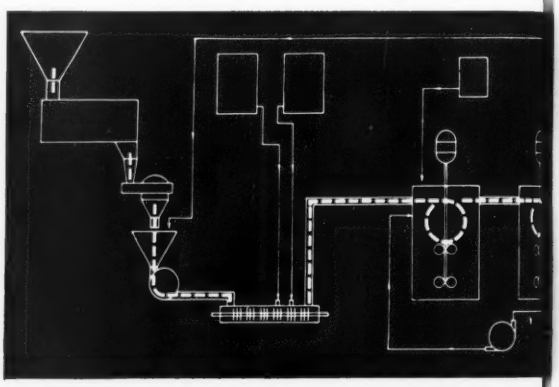

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STATEX-M FEF Fast Extruding Furnace
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WASHINGTON REPORT

By ROBERT E. L. ADAMSON

Continuing Legislation before Congress Will Involve Rubber Industry

The prospect for tax legislation is just one of a number of major bills of interest to the rubber industry as the second session of the 85th Congress gets to work.

With President Eisenhower's new $73.9 billion fiscal 1959 budget disclosed to be only precariously balanced, tax reductions are out this year, at least. There looms large in the situation, however, an important "but." Influential Democratic legislators can be heard talking about tax cuts, after all, if the general state of the economy keeps nosing downward. They are cognizant of the need of huge amounts of cash to finance missile defenses against the Soviet threat; they also are aware, as they eye growing unemployment figures, of the need of a recession "hedge" should the sagging economy get out of hand.

Taxes

At present the best approach Democratic strategists have come up with is a possible suspension of a portion of corporate and personal income tax rates. Standby legislation could provide that a piece of the 52% corporate rate and similar relaxations of personal income levies would be lifted automatically when the jobless roster reached, say, 5,000,000. The suspension could cut in at such a point that economic activity would benefit from fresh injections of cash.

Prices

Legislation to limit "good faith" as a defense in price discrimination cases (S-11), vigorously opposed by rubber manufacturers, will again occupy front stage center. Rep. Wright Patman (Dem., Tex.) is filing a petition of discharge with the House to pry loose the Judiciary Committee's stranglehold on the "good faith" bill and get it to the floor for a vote; it passed the House by a big majority in the last Congress. Sen. Estes Kefauver (Dem., Tenn.) will employ similar tactics in the Senate to get the controversial legislation up for a floor vote. Kefauver so far has been unable to break the bill out of the upper chamber's Judiciary Committee, but he reportedly has the votes to rescue it from its pigeonhole.

The Senate Judiciary Committee at the same time, after its "administered-price" investigation that now deals with the auto industry, will later go into food products and will launch a probe of the foreign operations of large American industries. The group wants to know if U. S. firms with extensive foreign holdings — such as the rubber companies — are inviting nationalistic expropriation with business practices that fly in the face of stated Administration anti-colonial foreign policies.

Trade

Also in the foreign field and an "absolute must" bill being requested by the Administration is the proposed five-year extension of the Reciprocal Trade Program, with new authority to reduce tariffs by another 25%.

Coupled with this is a renewed request for Congressional approval of the Organization for Trade Cooperation (OTC). OTC has practically no chance of passage; Administration officials admit privately, in fact, that they will use it to negotiate for a stronger reciprocal trade bill. But that legislation, too, is in serious trouble. Bipartisan opposition is ominous; what is worse, traditional Democratic support, according to observers, is "too quiet." A consensus is growing that the best the Administration can get is a three-year extension. The pessimists say it will be only a one-year program.

Related to the trade program, the State Department has declared a neutral position on the Sadlak bill to close another loophole in the American-selling-price principle of import protection for rubber-soled footwear. Thus the way seems clear for enactment of the bill, which would stop importer evasion of higher duties by use of leather eyelets and other trim on rubber footwear.

Finally the Roosevelt Subcommittee of the House Small Business Committee may look into alleged malpractices in the marketing of tires, batteries, and accessories (TBA).

Malayan Minister to United States Emphasizes Natural Rubber Reappraisal

The Federation of Malaya, newest member of the Commonwealth of Nations, began last month to flex its youthful muscles of independence and to make itself felt as an autonomous country with a big stake in the production, marketing, and promotion of natural rubber. After an increase of ¼-cent in the tax collected on Malayan rubber to support research and development, the Malayan Minister to the United States, Ismail Bin Mohamed Ali, sat down for an interview with RUBBER World on other possible action.

Malaya Rubber Plans

What he had to say added up primarily to an awareness that Malayan rubber faces a stiff competitive fight with synthetic rubber and that the new government must do what it can to see that natural is in a position to meet this competition.

Malaya became an independent nation late last summer, when the British Government dropped out after a period of semi-autonomy and Malay citizens moved into responsible administrative jobs. In September, Ismail left his job as chief of the division of trade to come on to Washington as Minister to the United States. Behind him were almost two years of dealing with export and import problems (rubber, then tin, the chief exports, and rice, the chief import). Before that time he had served in the economic division of the Malayan treasury. His educational preparation for government service included nine years of schooling in England.

Rubber, Ismail made it clear, has been a major factor in Malaya's position as one of the wealthiest countries in the Orient and the highest dollar-earning country in the entire Sterling area—thus Malaya's deep interest in

nourishing present natural rubber markets and attempting to build new ones as rubber production increases.

For several years natural rubber marketers have been able to sell all they can produce, and this unique situation —even in the face of growing synthetic competition—promises to hold true at least through the 1950's.

Beyond that, the program of replanting Malayan and other rubber acreage with high-yielding trees will begin to increase significantly world production of natural rubber. The double effect of this output is expected to make more rubber available at lower production costs, since each acre of new trees will produce two or three times as much rubber with little extra cost effort.

New Research Emphasis

At year-end the Federation of Malaya announced its first move toward preparing itself for this competitive fight—the increase to ¾-cent per pound in the half-cent tax which finances research on natural rubber. The higher cess became effective February 6. It was applied as an aftermath of the so-called Blackman Committee study conducted a year ago under natural rubber industry auspices. One of the Committee's recommendations was an increase in spending on research and development.

Ismail pointed out that increased research effort was aimed chiefly at (1) finding new uses for natural rubber, and (2) improving natural to meet the threat of new developments in the production of synthetic. The manufacturers of synthetic (most of them in the U. S.) spend "far more money on research than the natural rubber producers do," Ismail emphasized.

Price and Promotion

Aside from increased research effort, in two other major areas the new government would like to see some improvement—if there is room for improvement. They are: price and promotion. Ismail estimated that 50,000 acres of Malaya have been planted to new, high-yield trees in the last 2-3 years, and the replanting program still is incomplete.

"We want to bring prices down, and we can only bring prices down by increasing production," Ismail declared.

Where government land is sought for rubber planting, it must be replanted to high-yielding trees. By 1952 the goal is to have 1.4 million out of a total of 2.0 million acres of Malaya's rubber trees producing at high yields.

Some 90% of all Malayan revenues stems from exports of rubber and tin; rubber is the larger of the two. Since the country is so dependent on rubber, Ismail observed, the Malays want to know if there is any way of improving price and promotional activities. By 1960 the first substantial impact of the last 2-3 years of replanting will be felt. With the cost per pound for producing natural down, the Malays feel, they will be able to sell more rubber at lower prices.

"The United States," Ismail observed, "is one of our major markets. We would like the U. S. consumer to buy more natural rubber. It all goes back to price and quality—particularly since natural rubber must compete with synthetic."

Because of its continuing dependence on the sale of rubber in world markets for its economic stability, the Minister explained, his government has embarked on a reappraisal of efforts to promote natural rubber in U. S. and other world-consuming areas. The study is being conducted, he added, in consultation with the Malayan rubber industry.

In the U. S. the reappraisal directly involves the Natural Rubber Bureau, which represents the Natural Rubber Development Board in London. NRDB, in turn, gets its rubber promotional funds from the Rubber Producers' Council, with headquarters in Kuala Lumpur, the Malayan capital. All Malayan producers contribute to the funds used by the 15-member Producers' Council to publicize rubber all over the world. The funds are collected by the government for the Council as the best administrative way to make collections from some 350,000 smallholders. Once the funds are collected, they are turned over to the Council, and the government has no further jurisdiction.

NRDB, with its headquarters in London, also has offices in Kuala Lumpur, Australia, New Zealand, South Africa, and (through the Natural Rubber Bureau) the United States.

It is substantially this promotional set-up which the new Federation Government has begun to review.

The review does not imply, Ismail emphasized, that current efforts are inadequate. But, as a newly independent country, he explained, "we want to see a reappraisal of all this."

BDSA and NRB Expect 1958 Rubber Use of More Than 1.5 Million Tons in U. S.

The United States Department of Commerce, reporting the results of the annual survey and forecast conducted by its Business & Defense Services Administration, predicted last month that demand for U. S. synthetic rubber would permit an increase in production during 1958 of 10.5% over 1957 output. At the same time the Department forecast a 3% rise this year in total U. S. consumption of both synthetic and natural rubber.

BDSA vs. NRB Forecasts

The official government figures for rubber ran fairly close to the annual estimates made at about the same time by H. C. Bugbee, president of the Natural Rubber Bureau. Production of synthetic in the U. S. in 1958 was put by BDSA at 1,210,000 tons, but BDSA's rubber expert, S. E. Overly, later scaled down this figure to under 1,200,000 tons; Bugbee estimated synthetic production at 1,150,000 tons.

Total consumption of both natural and synthetic in 1958 was estimated by the government at 1,525,000 tons; Bugbee put the consumption figure at 1,510,000 tons. Consumption of synthetics, according to the government, will run about 985,000 tons (later reduced several thousand tons by Overly); consumption, according to Bugbee, will total some 960,000 tons.

Allowing for the second-thought modifications by Overly, the two forecasts look remarkably alike. Overly pointed out that his forecast for the Commerce Department survey was prepared early in December, before the figures showing that synthetic rubber production was at high levels late in the fall became available. With consumption failing to follow the production increase in November, the carry-over from 1957 into early 1958 indicates a total increase by U. S. synthetic producers of about 9%, he said, against the 10.5% figure used in the official forecast.

Overly looks for an increased demand in three principal areas of the synthetic market—replacement tires for 1955 automobiles (1955 was the biggest year in history for auto sales), retread rubber (reflecting the manufacture of stronger casings), and in the export market, where synthetic sales have grown with a rush in 1956 and 1957.

"It is difficult to forecast the consumption of the other segments of the rubber industry," Overly pointed out. "New installations requiring rubber products in the heavy industries, mines, etc., may not show much increase, but renewals on installations made during 1952-55 period may show gains over 1957.

"The consumption of synthetic rubber should increase percentage-wise to total consumption (with natural rubber's share of the market declining). U. S. consumption for the synthetics, based on a 1,525,000-ton estimate for total consumption, should be about 985,000 tons."

SR Use Abroad

"Exports of synthetic rubbers should show an increase. Technically the market is still very large. It is difficult to calculate the percentage of synthetic

to total rubber consumption abroad, but, excluding Soviet Russia, U. S., and Canada, it does not reach 20%, compared to 63% in the U. S. The movement abroad (toward synthetic) has been accelerated the last few years.

"Reports indicate that new production will start the latter part of 1958 in West Germany, United Kingdom, and Italy. Dollar exchange may not be available to satisfy all the demand (for U. S. synthetics). Discounting these factors, the U. S. should increase its exports of synthetic rubber in 1958 to approximately 10% to 225,000 tons. . . .

"Any serious trouble in the natural rubber producing areas of the Far East would have a tendency to increase the production and consumption of synthetic rubbers."

Bugbee predicted that natural would have another year in which only some 25,000 tons more than required will be produced. In 1957, he estimated, the surplus of production over consumption was 30,000 tons. In 1958, as in 1957 and for several preceding years, he prophesied, natural rubber will continue to demand a premium over general-purpose synthetic.

ODM Becomes Interested in Rubber Mold; NBS Gets Five-Year Research Contract

Defense Mobilizer Gordon Gray reported to Congress in January that the National Bureau of Standards is ready to begin what has all the earmarks of a most important research effort on the why and wherefores of the mold which sometimes forms on natural rubber. Gray expressed the hope to Congress "that the results of this research may help reduce the volume (3,500 tons monthly)" of rubber rotated out of the stockpile to keep the 1.2-million ton inventory fresh. But it was just as apparent that a clear answer to the main question—Does mold actually harm rubber?—would have a tremendous impact on commercial rubber activities.

Research Contract to NBS

Over the many months before a research contract was actually awarded to NBS by the stockpile authorities, a number of government officials were involved. The Defense Materials Service, with immediate supervision over the stockpile, approached the Prevention of Deterioration Center maintained by the National Academy of Sciences and National Research Council, asking for help on the mold problem. The Center went to work compiling all of the world literature it could lay its hands on and came up with the declaration that nobody knew for sure whether rubber mold actually affected the rubber. Out of this piece of advice grew the modest but important research contract awarded to NBS.

Lawrence A. Wood, chief of the Rubber Section of the NBS Organic & Fibrous Materials Division, is heading up the small group of men who will tackle the job. The research contract, awarded to NBS in December, is not big enough "to keep somebody busy" on a full-time continuing basis during the five-year length of the study, Dr. Wood said. So, he explained, the program has been set up to allow certain tests for a month or so, then replacement of the test rubber in storage-like surroundngs for about a year before resumption of testing.

The emphasis will be on a study of the effects of mold on the properties of rubber. Do organisms utilize the hydrocarbons of rubber as a nutritional source? Do they feed on the carbohydrates or other impurities? If they get started on impurities, do they attack the rubber itself? Is the stickiness or softness of some rubber when it is delivered attributable properly to mold or heat? These are some of the key questions to be answered.

Commercial Aspects

George Casto, the DMS official who manages the stockpile, said NBS will work on three types of rubber from the government's supply—RSS #1, #2, and #3. He recalled that the stockpile's managers early in its history felt it was unsafe to store rubber beyond seven years. The still inadequate knowledge developed in the intervening years shows that rubber may be stored for 20 years. From the relatively narrow point of view of the government—involving substantial funds for inspection, storage, and rotation—it would be extremely helpful to know just how long rubber can be held and how best to hold it.

From a commercial point of view, of course, the answers to these questions are important, but there is the further possibility of scientific conclusions on the heretofore assumed opinion that mold is harmful to rubber and renders rubber less valuable. Most, if not all, contracts for the sale of natural carry a clause calling for downward price adjustments if the rubber is moldy.

"We know the molds grow on rubber," a government scientist pointed out, "but there is the possibility that they are not doing any harm. This would have to be settled first before one could go much further. . . .

"This is a question of real importance to the rubber industry because this could change their marketing practices considerably."

Research Scope Limited

Dr. Wood emphasized that the nature of the problem and the limitation on funds available gave the study some restrictions which industry interests might be in a position to circumvent with an allout effort.

"At the moment," he disclosed, "it will be merely a testing program with regard to mold. We are not making any biological study of the mold—rather the effect of the mold on rubber. At the same time, we hope to get some information on the conditions most favorable (to existence of the molds) and the conditions least favorable."

With such evidence in hand, he added, NBS would be in a position to advise DMS and its parent organization, the Office of Defense Mobilization, to store stockpiled rubber under certain conditions. He also indicated that NBS rubber experts have waited for a long time to get at the rubber mold challenge.

In commencing the job at long-last, Dr. Wood said it was "quite likely" that there is only one type of mold which attacks raw rubber and makes its vulcanizates suspect. This is another major question which NBS hopes to answer. As to whether and/or when the answers uncovered by the program will be made public, Dr. Wood said, the decision will have to be made by ODM Chief Gray.

In the meantime, the Prevention of Deterioration Center (NAS-NRC), ordinarily working for the Defense Department, has assumed the role of consultant to Gray. In addition to its work in compiling available literature on rubber mold research, it has sent men into the field to inspect rubber stored in government warehouses. Furthermore it will provide a panel of its scientists to make a final review of the NBS findings. Although, as Dr. Wood pointed out, publication of the panel's report is still in doubt, the non-secret nature of the program appears to be such as to bring early release to the public.

Higher NSF Budget; More Polymer Study

President Eisenhower told Congress in January that the "security and continued well-being of the United States depend, as never before, on the extension of scientific knowledge." He followed up this declaration in his annual budget message with a request to Congress for a near-tripling of the current spending level by the National Science Foundation. Estimated spending by NSF during the current fiscal year ending June 30 will add up to $50 million; for the year beginning July 1 the President has asked an appropriation for NSF of $140 million.

A significant amount of the $90-million increase projected for NSF will go for expansion of programs to improve high school and college science education. These programs, the President an-

nounced, include (1) action to interest able students in science careers; (2) measures to improve the methods of teaching and the content of courses in mathematics and science and to give supplementary training to college and high school teachers; and (3) provision for fellowships to highly qualified college graduates and scientists for advanced study in science and mathematics. Some $82 million in authority to spend—or more than four times the current figure—has been requested for these programs.

Another large hunk of the increase in NSF's 1959 request—$58 million—will go to fund a sharply expanded program of basic research grants, construction of new research facilities, and related activities. Under the program of basic research grants, NSF is already supporting a fairly substantial level of work on high polymers at 11 universities and the National Bureau of Standards. Most of these grants expire this year and next, but NSF's advisory panel on high polymers is scheduled to meet early this year to decide where to proceed from the present research base.

The high polymer program, as it now exists, costs the Foundation between $600-$700,000 annually. This compares with total grant-in-aid spending of about $40 million annually. The scheduled increase of grants to a total $58 million in fiscal year 1959 bodes well for some increase in the high polymer program. This possibility is bolstered by budget figures showing that the current estimate of 975 research grants made by NSF in the fiscal year ending June 30 will be more than doubled in the coming fiscal year to some 2,400 grants.

Among NSF's accomplishments during fiscal year 1957 was the complete transfer of all research and development reports dealing with synthetic rubber to the Office of Technical Services of the Department of Commerce. OTS, in turn, has made all reports for the period 1949-1955 available for public sale through the Library of Congress. If the demand warrants it, earlier reports will be made available also.

NSF inherited the research and development functions of the Federal Facilities Corp. with respect to synthetic rubber, on July 1, 1955. Since then the government's research activities have swung from the relatively narrow field of synthetic rubber to the broad area of high polymers.

FTC Tire Ad Guides; Price-Fixing Charges

The Federal Trade Commission is expected to make two moves later this month or in March, at the latest, of major significance to the rubber industry. Due for publication momentarily is the long-awaited set of tire advertising guides[1] designed to halt "confusing" promotion. Also due in the near future is a series of price-fixing complaints against major rubber manufacturers.[2]

FTC's price-fixing investigation, in progress for some time, was speeded up toward the end of 1957 and early this year. Reliable sources close to the investigation say it will culminate in the issuance of formal complaints within the next few weeks. The sources said the price-fixing charges will be aimed primarily at Firestone, Goodyear, Goodrich, and U. S. Rubber, but that smaller rubber firms may be named as purported coconspirators.

The advertising guides have been in the works since prior to Labor Day. They were issued in mid-fall as tentative proposals, with interested industry parties invited to comment. The early rush of replies from dealers was heavily favorable. Later comments from tire manufacturers were reported to be "generally excellent" in tone of approval, with a sprinkling of suggested changes in wording. Thus FTC was expected to accept the overwhelming vote of approval from industry as a vote for early finalization of the guides.

Simultaneously with the anticipated actions of FTC on tire advertising and price-fixing allegations, a Senate Small Business Subcommittee headed by Hubert Humphrey, Minnesota Democrat, decided to shelve its plans to bring the FTC on the Congressional carpet of public hearings. The Humphrey Subcommittee was expected, instead of public hearings, to conduct informal staff negotiations with the Commission on the possibility of following up the advertising and price-fixing actions with a new attempt to fix a ceiling on quantity-discounts given to large tire purchasers. The last FTC attempt to set a limit (20,000 pounds) was thrown out of the Federal Appeals Court here.

[1] RUBBER WORLD, Nov., 1957, p. 268; Jan., 1958, p. 579.
[2] RUBBER WORLD, Oct., 1957, p. 100.

INDUSTRY NEWS

Plastics Industry 1957 Gain 7%; Expects 1958 Increase of 2%

A gain of 7% in the plastics industry occurred in 1957 as the production of plastics and resin materials reached another new high of approximately 4,387,000,000 pounds, including cellulosics, according to the Society of the Plastics Industry, Inc. It compares with the previous year's actual figure of 4,124,441,302 pounds, including cellulosics.

A breakdown of 1957 production figures for plastics and resins for some of the principal materials was estimated as follows:

Materials	1,000 pounds	% Change from 1956
Polyesters	94,800	+30.7
Cellulosics	151,000	+ 3.5
Polystyrene	635,400	+ 1.1
Polyethylene	682,800	+22.6
Vinyls	841,200	+11.8
Urea and melamines	308,500	− 2.8
Phenolics and other tar acid resins	475,900	− 7.1

The dollar sales picture for molders and extruders did not keep pace with the growth in poundage for output in this important segment of the industry based on monthly sales statistics compiled by the SPI, which was felt to be due, in part, to keen competition resulting in lower prices.

The SPI mold sales statistics, generally regarded as an indication of the future trend of new business, continued to run a bit higher than in 1956. New mold sales were up 2½% in 1957, in contrast to a 16% increase in 1956 over 1955.

The SPI conducted a survey on general business conditions in the plastics industry among its 950 member companies in the United States. Replies were received from 32% of these companies with regard to the business for the first six months of 1958, as compared with that for the first half of 1957. Higher sales in 1958 than in 1957 were predicted by 50% of the companies replying; whereas 68% pre-

dicted higher sales in 1957, as compared with 1956, when the same survey was made a year ago. About the same sales in 1958 were predicted by 35% of the companies, while a year ago 27% saw the same sales volume for the first six months of 1957, against the first half of 1956. Lower sales in 1958 are expected by 11% of the companies in 1958. Last year only 4% expected lower sales in 1957, as compared with 1956 sales.

While only 50% of the companies replying indicated that they planned any expansion at all in 1958, the extent of the planned expansion ranged from 5% to 600%. Most of the companies planning to expand more than 10% were smaller companies. Planned expansion for the large companies varied in the main between 5% and 10%.

All types of thermoplastic pipe produced on a proprietary as well as a custom basis reached a total of approximately 58 million pounds in 1957, as compared with about 55 million pounds in 1956. Produced from polyethylene, cellulose acetate butyrate, polyvinyl chloride, and styrene base formulations, thermoplastic pipe is expected to reach 60 million pounds in the current year.

Cellular plastics, also known as foamed plastics, produced from basic resins such as vinyl, urethane, and polystyrene, exceeded 30 million pounds in 1957, nearly a 100% increase over the 16 million pounds produced in the previous year. It was estimated that production will expand to about 40 million pounds in 1958.

One of the outstanding developments in the plastics industry in 1957 was the availability of high-density polyethylene, and late in 1957 a second member of the olefin family, polypropylene, made its appearance in the European market, and in December one American chemical firm went on-stream with a commercial plant for its production.

The squeeze on profits in the plastics field may be expected to intensify further in 1958, the SPI said. Certain branches of the industry, particularly those in their early growth stages should forge ahead volume-wise, but it is doubtful if this gain will offset declines elsewhere during the early months of the new year.

Based upon the overall business picture as well as the plastics industry's expansion plans, it looks like a 1% or 2% overall increase in plastics output this year, the SPI concluded.

Firestone Optimistic For Industry in 1958

Harvey S. Firestone, Jr., chairman of the Firestone Tire & Rubber Co., reported that passenger-car tire replacement sales at about 57.4 million in 1957 established a new record high, and he predicted that another record will be set in 1958, in his year-end business report. He added that year-end reports indicate the rubber industry sold about 107.5 million tires for passenger cars, trucks, and tractors in 1957. These figures, which include original-equipment and replacement tires, were 5% greater than in 1956, when 102,322,000 tires were sold.

Mr. Firestone attributed the increased tire sales to the constantly growing number of automobiles, the trend toward suburban living, and improved highways and roads. He said approximately 63 million cars and trucks were in use in the United States at the end of 1957, compared with 60.6 million at the end of 1956. It was estimated that by the end of 1958 there will be about 65 million cars and trucks in use in this country. Automobile production in 1957 was estimated at 6,125,000 units a 5.6% increase over the 1956 production of 5,802,000. Current reports indicate new car production in 1958 would approximate 5,850,000.

Gross sales by the rubber industry in 1957 would amount to $6.5 billion, and Mr. Firestone considered the outlook for the industry as very good.

In preparation for future demand for rubber products and for industrial growth, Firestone spent $68,768,000 for expansion during its 1957 fiscal year (which ended October 31, 1957). This expansion was the greatest in the 57-year history of the company and some $10 million ahead of the $58,570,000 spent for expansion, improvement, and modernization during the 1956 fiscal year.

Seiberling Sees Sales Prospects Good in 1958

Sales prospects for the rubber industry in 1958 look good, according to J. P. Seiberling, president and chairman of Seiberling Rubber Co. Total passenger-car tire sales should continue at their present levels, and truck tire demand may be expected to improve after a 1957 drop, he added.

In the year 1957 the rubber industry itself again showed its strength. It has given further evidence that the job of keeping America's automobiles, old and new alike, equipped with tires and rubber accessories is linked to an ever-expanding market, Seiberling said.

Although none of the industry can afford complacency, we should look forward to 1958 with optimism about further sales increases. Several factors indicate good reasons for this attitude, Seiberling explained.

Today 75% of America's families own cars. These motorists traveled half a trillion miles in their cars in 1956, and for 1957 the mileage traveled, when computed, will be greater.

It is apparent that people consider the automobile a virtually indispensable part of their lives. Motor vehicle travel has almost doubled in the last 10 years, and in 1956 people spent nearly 10% of their disposable income to operate their cars.

With no severe setbacks in sight for the economy, Seiberling said it is reasonable to expect this trend to continue.

Monsanto Carbometal PVC Plans in Argentina

Monsanto Chemical Co., St. Louis, Mo., and Carbometal S.A.I.C., Mendoza, Argentina, are working out an arrangement for the manufacture of vinyl chloride monomer and Opalon, Monsanto's polyvinyl chloride, at a new plant to be constructed at Mendoza.

It is anticipated that construction of the new manufacturing facilities will begin during the first half of 1958. When completed, the plant will be capable of filling presently estimated needs of polyvinyl chloride in Argentina.

The plant will produce both flexible and rigid types of polyvinyl chloride resins. These resins are used by plastics manufacturers for such diverse products as appliance parts, piping, welting, belting, gasketing, electrical insulation, phonograph records, sheeting for upholstery and rainwear.

Carbometal, one of the leading producers of calcium carbide and ferro alloys in Argentina, recently started construction of steel and coke producing facilities at Nihuil in the southern part of Mendoza.

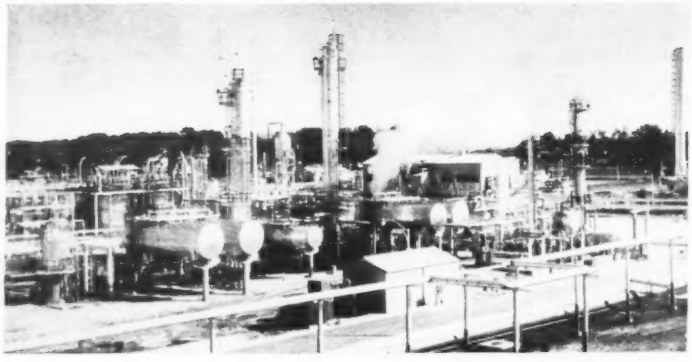
Lintafoam Is Licensed By Sterling Alderfer

The Sterling Alderfer Co., Akron, O., has licensed the Lintafoam Co., of Loudwater, England, to manufacture Foamedge products, using the Alderfer developed process of manufacture. Foamedge is the trade name of a group of products made of polyurethane foam, such as weatherstripping, garage-door bumper-seals, grommets, refrigeration and air conditioning seals, automobile window seals, vacuum cleaner and mop bumper strips, and a multitude of home and auto uses.

United States production is by The Sterling Alderfer Co., which has achieved national distribution in little more than one year.

The Lintafoam Co.'s plant, at Loudwater, is about 30 miles from London. Machinery is now under construction in Akron and production of Foamedge products in England is expected to start in early spring.

It is also reported that negotiations are in process for licensing Foamedge manufacture in several other countries.



Grace's new high-density polyethylene plant

W. R. Grace & Co. Announces Versatile Program

At a luncheon and reception at India House, New York, N. Y., W. R. Grace & Co. announced three important events all occurring within its versatile framework: the christening of its new $25-million ship, *Santa Paula;* the dedication by its polymer chemicals division of a 50-million-pound high-density polyethylene plant at Baton Rouge, La., and the completion of the first building of the company's new $5-million Washington research center near Clarksville, Md.

Marlin G. Geiger, executive vice president in charge of the Grace chemical group, announced that the research center will be under the direction of William P. Gage, president of Grace research and development division, who was introduced at the luncheon. The speaker reported that the new laboratories will concentrate on research in the field of polymer chemistry, and, in addition, they will implement the catalyst research program for Grace's Davison chemical division, one of the foremost producers of catalysts used in Grace's low-pressure polyethylene plant as well as for forming catalysts used by oil refineries to raise the octane rating in premium gasolines.

J. S. Fluor, president of Fluor Corp., Ltd., Los Angeles, Calif., who engineered and built the new Baton Rouge plant, spoke briefly at the luncheon. The following information was disclosed: the new high-density polyethylene plant went on stream, November, 1957; capacity, 50,000,000 pounds annually; total investment; in excess of $20-million; total staff, 250; acreage, 150 acres, current plant utilizes 30; major raw materials, ethylene gas, solvent, and catalyst; operation, continuous process with high instrumentation; and design features, maximum safety, and maximum utilization of aluminum, including first all-welded aluminum dryers ever built.

Executives from the company's polymer chemicals division included T. T. Miller, president, who outlined the development of W. R. Grace & Co. since its entry into the U. S. chemical industry in 1952; E. E. Winne, vice president, toastmaster for the proceedings; and Willard de Camp Crater, marketing director, who announced some of the most recent uses for high-density polyethylene. Some of the latter included: first clear high-density polyethylene film for packaging applications; new safety plastic valve for water filter systems; "Grex" (the company's trade mark for high-density polyethylene) nose guard for football helmets; a floatable water-ski tow rope; boat bilge pump; and a variety of household items.

HVEC Expanding Abroad

High Voltage Engineering Corp., Burlington, Mass., plans to double existing overseas facilities for installation and service of its Van de Graaff particle accelerators. Already 27 installations are in Europe alone, with several others on order there.

The company has acquired 51% of the stock in High Voltage Servicing Co., Ltd., London, England, as the first step in this expansion program. HVSC has represented the Burlington organization since 1949 in maintenance and repair of Van de Graaff accelerators throughout Great Britain.

The British affiliate will service accelerators already installed in England and on the Continent, and will expand inventory and warehousing facilities by 100% to offer a complete selection of accelerator components for immediate shipment. Present sales and engineering staffs will be more than doubled, with special attention given to the training of personnel for installation and service. Eventually, HVSC will have responsibility for installation and maintenance of all Van de Graaff accelerators in Europe, Africa, and as far eastward as Calcutta.

Van de Graff accelerators are currently being used in the plastics and rubber industries as a source of radiation for polymeric irradiation purposes.

N. Y. Belting Absorbed

United States Rubber Co., New York, N. Y., has announced that it is consolidating the operations of one of its oldest subsidiaries, The New York Belting & Packing Co., with the sales and distributing organization of its mechanical goods division. The move is designed to strengthen the company's nationwide network of industrial rubber products distributors.

All of the company's industrial rubber products will now be sold under U. S. Rubber brand names. This policy will enable the company to strengthen and broaden its service to distributors as well as give them the advantage of far greater advertising and sales promotion.

New York Belting's sales and operating staff of approximately 100 persons will be integrated with U. S. Rubber's nationwide field sales organization. Joseph A. Conlon formerly vice president of N. Y. Belting, becomes marketing manager, transmission products.

New York Belting & Packing was one of the oldest industrial rubber products manufacturers, having been founded in 1846. It produced the first rubber-covered transmission belt, the first rubber-covered conveyor belt, the first wire braid steam hose, and the first rubber-bonded grinding wheel. It became part of U. S. Rubber in 1905.

Du Pont Aids Education

E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has awarded grants totaling nearly $1,150,000 to 135 universities and colleges in the company's annual program of aid to education. The total for the 1958-59 academic year is about $100,000 more than the company contributed for this school year.

Most of the increase and more than half of the entire program are grants to colleges and universities for strengthening the education of scientists and engineers. These grants will support the teaching of science and mathematics as well as other subjects. At the same time, grants for fundamental research are being continued, as are grants for fellowships, which once made up the entire plan. Du Pont's program dates from 1918.

As in previous years, decisions on the use of the funds and the selection of people to receive individual grants are left to the institutions.

Grants for teaching total about $664,000 in awards to more than 100 privately controlled colleges and universities, including 12 medical schools. Aid to fundamental research totals $309,000. A total of $155,000 for 40 fellowships in science and engineering on the post-graduate level has been granted. Grants for other university work round out the total program.

Pennsalt Installs Wide-Range Scott Tester

To meet the requests of customers for information on the physical properties of natural and synthetic rubber compounds over a wider range of temperatures, Pennsalt Chemicals Corp., producer of "Sharples" brand rubber chemicals, recently installed at its sales and service laboratory in Devon, Pa., testing equipment designed to furnish such information in the range —70 to +550° F. The equipment selected was the machine manufactured by Scott Testers, Inc., and equipped with an Accr-O-Meter electrical weighing and recording system and high- and low-temperature conditioning unit and test chamber, shown in Figure 1.

Figure 2 shows the test chamber with the specimen clamped in place. The Accr-O-Meter head mounted above the chamber contains a transducer unit which converts mechanical pull exerted by the specimen to an electrical impulse. The electrical energy generated by the transducer and proportional to the tension exerted by the specimen is recorded in psi. on the moving chart shown on the left in Figure 1. Squeezing a button held in the operator's hand causes the recorder pen to jump slightly, marking modulus values on the stress-strain curve as it is being drawn.

A load range of 0 to 5,000 psi. will normally be used, but this range may be easily changed by the insertion of different Accr-O-Meter heads designed for higher or lower load ranges. Full-scale deflection on the chart may be varied during a test from 10 to 100 pounds, providing accurate readings at low modulus (0-500 psi.) and at high modulus (500-5,000 psi.) on the same specimen. Jaw separation speeds of 1½ to 200 inches per minute can also be obtained with this unit.

The atmosphere conditioning unit with circular temperature recording chart and control switches is shown on the right in Figure 1.

Plans Large Fiber-Glass Yarn Plant

Pittsburgh Plate Glass Co., Pittsburgh, Pa., has disclosed that it will build one of the world's largest continuous fiber-glass yarn plants at Shelby, N. C. A multi-million dollar plant, the new unit will employ about 850 persons at capacity operation.

Construction work will get under way as soon as contracts for utilities have been signed, and options have been exercised on the plant site. The company holds options on approximately 135 acres of land in Cleveland County about six miles west of Shelby.

The company said that the one-story structure will contain more than 350,000 square feet of floor space and will be completely air conditioned to insure both maximum production quality and desirable working conditions.

Designed capacity of the plant will make it one of the largest in the fiber-glass industry. The new unit will have 16 glass furnaces capable of producing 25,000,000 pounds of yarn a year. It will employ the direct-melt system of making continuous yarn, and yarn will be twisted and plied on ring twisters specifically engineered for this plant.

Sun's Stearate to Witco

Witco Chemical Co., New York, N. Y., has acquired the stearate department of Sun Chemical Co.

Joseph L. Kearns, formerly sales manager of Sun's stearate department, has joined Witco in a similar capacity and will have direct supervision of this new stearate operation to assure continuity of service and quality. Existing personnel will continue to operate the stearate plant at Wood River Junction, R. I.

Prior to the sale, Sun conducted the stearate unit as a department of its Warwick Chemical division. Principal reason reported for the sale was that stearates are unrelated to the primary Warwick operation. This move will permit Warwick to concentrate more heavily on its expanded program of producing organic chemicals for the textile and paper industries.

The acquisition will provide Witco with production facilities for metallic stearates in four separate locations in the United States, as well as one in Canada. Witco reports it can now meet customer requests more readily for all types and grades of stearates.

Mr. Kearns will make his headquarters in Witco's executive offices at 122 E. 42nd St., New York.

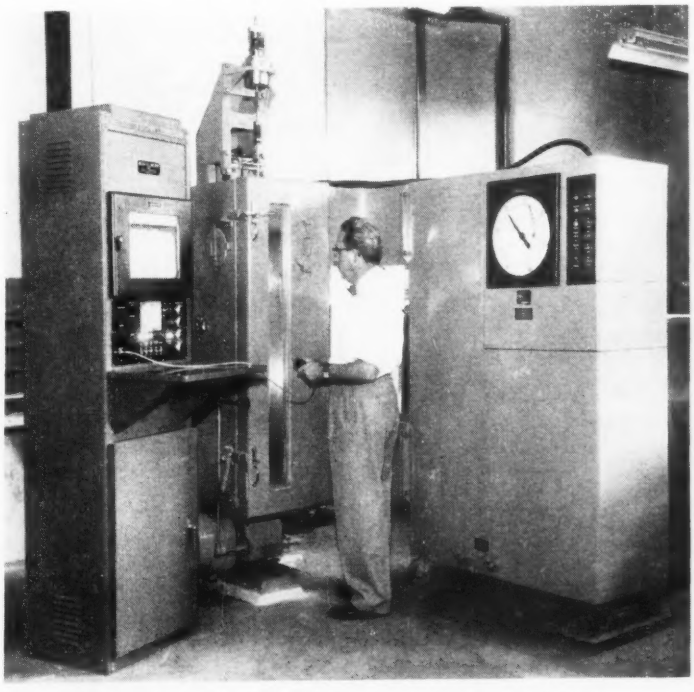


Fig. 1. Pennsalt's new wide temperature range Scott tester

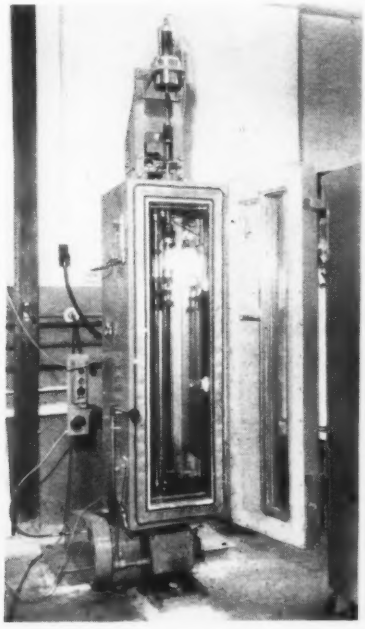


Fig. 2. Test chamber showing interior and Accr-O-Meter head

Eastman Reorganization

A reorganization of the field sales activities of the chemical division of Eastman Chemical Products, Inc., Kingsport, Tenn., into three regional areas and the appointment of regional sales managers have been announced by the company. Eastman Chemical Products is a subsidiary of Eastman Kodak Co. and markets the products of two of Kodak's principal chemical manufacturing divisions, Tennessee Eastman Co. and Texas Eastman Co.

The newly appointed regional sales managers include Robert H. Cannon, who has been in charge of the Chemical division's New York office for the past several years. Cannon will now direct the sales of chemicals and dyes in the New England and Middle Atlantic States including the operation of the company's distribution center at Lodi, N. J.

John H. Sanders becomes regional sales manager for those areas served by the division's Cleveland, Cincinnati, and Greensboro, N. C., offices plus other areas of the South and the Southwest. Sanders was formerly in charge of the division's Cleveland office and, more recently, product manager for all chemicals produced at Kodak's Texas Eastman Co. division.

Decatur B. Campbell, Jr., has been named regional sales manager of the Midwest area and, as such, will direct the sales of the division's products in those areas served by the company's Chicago, St. Louis, and Houston offices. Prior to this appointment Campbell was in charge of the Chicago office.

As a major chemical producer, Eastman supplies antioxidants, antiozonants, solvents, plasticizers, and chemical intermediates for the rubber industry.

Du Pont LCM Method

A process for continuously vulcanizing neoprene solid and cellular extruded shapes has been developed by rubber chemists of E. I. du Pont de Nemours & Co.'s elastomer chemicals department. Called the Du Pont LCM (liquid curing medium) Method, it involves passing the extruded section directly into a bath of molten metal or an organic fluid maintained at temperatures of 400 to 600° F. Full vulcanization is obtained in 20 to 30 seconds with most cross-sections.

The new process will assist manufacturers of extruded neoprene products to reduce manufacturing costs by streamlining production techniques. In addition, improved surface appearance and tolerance control are realized.

A number of companies have begun commercial use of the LCM Method. One concern has reported cost savings of 25% over costs by conventional curing methods.

Goodyear Natsyn Plant

Production of Natsyn, a new-type synthetic rubber which has the molecular structure and performance characteristics of the natural tree-grown product, has moved from small-batch laboratory scale to a tonnage basis with completion of a large new pilot plant by The Goodyear Tire & Rubber Co., Akron, O.

Goodyear's highly instrumented pilot plant, built at a cost of approximately $750,000 and designed exclusively for the production of Natsyn, has a tonnage capacity which will enable extensive production scale tire building and evaluation trials. This accomplishment is said to open the door to early further expansion in the field. Goodyear expects soon to undertake the engineering of a full-scale Natsyn production plant with 25,000 to 30,000 tons annual capacity.

Goodyear scientists first had success in making a synthetic natural rubber with the dynamic properties of the tree-grown product in 1955. Until now, production had been on a small-batch laboratory scale.

Full commercial production of Natsyn depends upon the availability of isoprene, a petroleum derivative from which the synthetic natural rubber is made. At present, the supply of isoprene is inadequate, with only one commercial producer in the United States. Potential producers, however, appear to have the development processes for making a low-cost, high-purity product well under way.

Kennedy ASTM Medalist

American Society for Testing Materials Committee D-13 on Textile Materials will present the Harold De Witt Smith Memorial Medal to Stephen J. Kennedy, research director, textile, clothing, and footwear division, Quartermaster Research & Development Center, Natick, Mass. The presentation will be made on March 20, during the spring meeting of Committee D-13, March 18-21, at the Sheraton-Park Hotel, Washington, D. C.

The medal is a testimonial to the memory of the late Harold De Witt Smith, who pioneered in the concept of an engineering approach to the evaluation of the properties of textile fibers and to their utilization. It was endowed by Fabrics Research Laboratories, Inc., Boston, Mass., and is awarded at intervals of not less than one year by Committee D-13 for outstanding achievement in research on fibers and their utilization. This presentation is the ninth of the medal.

Dr. Kennedy has had a distinguished career in the service of the U. S. Army Quartermaster Corps during World War II and subsequent thereto.

New Neoprene Thread

Easthampton Rubber Thread Co., Easthampton, Mass., is using neoprene compound of special composition to make a cut thread resistant to chlorinated solvents. Since 1939 the firm has worked closely with Du Pont in the use of its neoprene for making rubber thread. During World War II when natural rubber was not available, Easthampton consumed several million pounds of one of the earlier types of neoprene. The resulting thread was reported to be very satisfactory in normal elastic webbing, but unsatisfactory in dry cleanable webs.

Cooperation between the laboratories of the two companies at last resulted in the development of a neoprene polymer early in 1956, which showed promise of being what was needed. It then became the job of Easthampton to develop the best formulation of this polymer and chemicals for the thread rubber end-product. The records indicate that more than 200 formulae were made up and tested before the company was satisfied with the results and ready to try them in factory production.

To summarize, after many years of effort an elastic thread has been developed which, when woven into properly designed webs and attached to a garment will allow that garment to be dry cleaned many times without excess deterioration of the rubber thread. Easthampton has ample manufacturing equipment to produce such threads. It is still a special item designed especially for dry cleaning in the standard dry cleaning solvents, perchlorethylene and Stoddard solvent, with the added advantage of excellent heat-resistant and non-discoloring properties.

Development work is continuing by both Du Pont and Easthampton to make other compounds which will find use in a wide variety of elastic webbing in other fields.

Form Anchor Industries

Anchor Rubber Products, Inc., and Doan Mfg. Corp. were combined under one corporate name—Anchor Industries, Inc., 1725 London Rd., Cleveland, O. According to B. Kravitz, chairman of the board, and O. C. Kravitz, president, Anchor Rubber Products and Doan Mfg. become divisions of Anchor Industries. The Anchor Rubber and Doan divisions will continue with their established sales policies.

The consolidation was said to represent a move toward greater expansion and to facilitate product diversification.

In two newly created posts on the board of directors, I. A. Kravitz has been named executive vice president, and Walter S. Lepene, vice president, sales.

Rubatex To Expand

The Rubatex Division of Great American Industries, Inc., producer of closed cellular rubber products for industry, has embarked upon a $1-million expansion program. This program, the largest in the division's history, will include both additional plant facilities and equipment at the division's headquarters in Bedford, Va.

The expansion has been made necessary, it was reported, by an increased demand for the division's products among its traditional customers in the automotive, air conditioning, heating, sporting goods, and footwear industries as well as to meet the needs of such new markets as electronic instrument cases, skin diving suits, aircraft and construction. The expansion will boost capacity almost 50%.

A second plant, originally occupied by Continental Can Co., has been purchased in Bedford. This brick building will be used for secondary manufacturing operations, additional warehousing, packaging, and shipping. The principal rubber making functions will remain at the division's main Bedford plant.

A considerable portion of the equipment outlay will be devoted to the development of new materials and processes. Additional laboratory facilities are included in the program to guarantee the firm's continued leadership in the closed cellular rubber field.

A major breakthrough accomplished during the past year by the division was the development of a new process for extruding closed cellular rubber in any linear shape desired by industry.

W. Earle Henderson

Sun To Make Housewares

The Sun Rubber Co., Barberton, O., doll and toy manufacturer, will reenter the housewares field in 1958, producing Sun-Ware rubber and plastic housewares. The firm will utilize color techniques and skills learned from years of doll and toy production, to manufacture a housewares line of at least 12 items.

The Sun-Ware line will include semi-rigid drainboard trays in pastel colors; flexible drainboard mats; three stove-top mats in perforated and solid rubber; sink-bottom mats for standard and twin sinks; bath mats; and specialties including spatulas, plate scrapers, soap dishes, sink stoppers, bottles, clothes sprayers, and insecticide dusters.

The company, returning to a field in which it has had considerable experience, will confine its line to white and four colors. These will be consumer-tested colors, with demonstrated acceptance by the housewife.

W. Earle Henderson, Sun's rubber division general manager, will head the sales staff for Sun-Ware. He will have overall supervision of three sales districts, eastern, central, and western. Keith Scanlon, now in industrial design sales at Sun, has been named to the housewares sales staff and will have charge of the central division. An appointment will be made later to head up sales activities in the 11-state western territory.

The move is also the latest step in a diversification of product program by the firm. All Sun dolls and toys are now made of vinyl and that has freed a completely equipped rubber laboratory and rubber division to develop and produce a diversified line of plastic and rubber products.

F-B Licenses Pomini

Farrel-Birmingham Co., Inc., Ansonia, Conn., has licensed S. A. Luigi Pomini, Castellanza, Varese, Italy, for the manufacture and sale of the complete line of F-B rubber machinery, including Banbury mixers, mills, calenders, and extruders. These machines will be made in strict accordance with Farrel-Birmingham designs.

Pomini is an old, well-established machinery manufacturer, employing about 500 people. For many years one of Italy's leading manufacturers of gears, gear drives, mining machinery, and rolling mills, Pomini, since 1949, has also engaged in the manufacture of rubber-processing machinery, including Banbury mixers under license from David Bridge & Co., Ltd. Inquiries for equipment of this type can be sent directly to Pomini.

Farrel-Birmingham will continue its present connection with David Bridge & Co., Ltd., Castleton, Rochdale, England, which has been manufacturing Banbury mixers and other rubber machinery in association with Farrel-Birmingham for nearly 40 years.

2-4-D Ups Latex Yield

A chemical well known to the weekend gardener as a weed killer has dramatically increased latex production on Far East rubber plantations where it has been used experimentally as a growth stimulant. The chemical is 2-4-D, used by gardeners to kill broadleaf weeds such as dandelions. United States Rubber Co. has been testing it on its rubber plantations in Malaya and Indonesia for the past five years as a hormone, or growth stimulant.

In the tests, latex yields have been raised as much as 25 to 40%. The chemical has also rejuvenated older trees and added years to their productive life. Under hormone stimulation some young trees have produced latex at a yearly rate of 2,000 pounds per acre. The stimulating effect of the chemical has also kept some trees up to 50 years old, producing at a profitable rate.

Less than an ounce of the chemical is used on a tree. Mixed with brown, syrupy palm oil, it is painted on a narrow section of the tree trunk from which the bark has been peeled away. The oil is a carrier for the chemical which is absorbed into the system of the tree.

Cross-breeding techniques and improved methods of fertilization, developed over the past quarter of a century, have considerably increased the life and the yield of rubber trees from the days when they grew wild in tropical jungles. Today's rubber trees have a life expectancy of 35 to 45 years.

From their fifth to ninth year rubber trees on modern estates yield latex at a yearly rate of about 600 pounds an acre. After the ninth year, through to about the twenty-seventh year, latex output is raised to about 1,200 pounds a year an acre. Yields then decline to about 700 pounds per acre each year as the tree ages.

Goodrich-Dutch Firm

A new company has been formed jointly by B. F. Goodrich Chemical Co., Cleveland, O., and Algemene Kunstzijde Unie N. V., Arnhem, Holland, to manufacture special-purpose synthetic rubber. Design and construction of a plant at Arnhem will proceed immediately, with completion scheduled for mid-1959. It was said that the new facility will be the first plant in Continental Europe using the Goodrich company know-how to produce synthetic rubber.

Products will include SBR-type latex, used in making foam rubber; high-styrene reinforcing polymer, used mainly in shoe soles; and Hycar nitrile latex, used in leather finishes, textile sizing and finishing, paper saturation, and as a binder for non-woven fabrics.

Thiokol-Callery Make Rocket Engines, Fuels

New super-efficient rocket engines are being developed by Thiokol Chemical Corp., Trenton, N. J., using solid high-energy fuel to be produced by Callery Chemical Co., Pittsburgh, Pa. Under terms of a working arrangement recently announced, Callery, developer of HiCal, a new high-energy boron-based liquid fuel will produce the solid fuel, and Thiokol, pioneer producer of case-bonded, solid propellant rocket engines, will develop the rocket engines. Development work on new rocket propellants utilizing HiCal is reported to be already under way at Thiokol's Elkton and Redstone divisions.

Last year Callery announced plans to produce HiCal in solid form. Pilot quantities of the new fuel will be available for larger-scale rocket tests in 1958.

Thiokol operates four rocket divisions. One is a government-owned research and development plant at Redstone Arsenal, Huntsville, Ala. Another government-owned, Thiokol-operated division is a rocket production plant at Longhorn Ordnance Works, Marshall, Tex. Thiokol also operates its own rocket plants at Elkton, Md., and Brigham City, Utah. The Utah plant, opened formally October 17, 1957, is specifically designed for production and testing of very large rocket engines.

R-B-H Dispersions In New Division

Interchemical Corp., New York, N. Y., has consolidated its R-B-H dispersions and textile colors divisions into a new color and chemical division. William N. Davies, formerly division president of textile colors, will be the general manager of the new unit. William J. Rothemich will be general production manager, and Harold D. Craft will be general sales manager of the color and chemicals division, which has headquarters at Hawthorne, N. J. The Bound Brook factory will continue its production of pigment dispersions under the R-B-H trade mark for the coatings and plastics industries under the immediate direction of William T. Hulse; while the sales organization for the products will remain under the direction of Richard L. Lynch, whose title will be sales manager-coatings and plastics industries. Philip H. Ingham will continue to head the Bound Brook laboratory as manager of development-dispersions for coatings and plastics. Albert Saunders will be manager of the newly established commercial development and evaluation department; while Ludolph H. Conklin, Jr., will be assistant sales manager-coatings and plastics industries in addition to continuing as manager of technical sales service.

Traflet Retires; Will Do Consulting Work

Frederick E. Traflet, vice president in charge of sales and research for Pequanoc Rubber Co., Butler, N. J., retired on January 1 after 34 years with the company.

Mr. Traflet was graduated from New York University with a B.S. degree in chemical engineering and joined Habirshaw Cable & Wire Co. In 1923 he went with Pequanoc Rubber Co. as chief chemist and remained with the company until his retirement.

Mr. Traflet has long been active in various trade organizations as past president of the Rubber Reclaimers Association, past chairman of the New York Rubber Group, and as a member of the American Chemical Society, Society of Plastics Engineers, and the Chemists' Club of New York.

After an extended and well-deserved rest Mr. Traflet, whose home is at 39 Elm St., Butler, N. J., plans to act as consultant in chemical, market, and sales problems in the rubber field where his wide experience and acquaintanceship will prove valuable.

Frederick E. Traflet

Woloch Purchases Pequanoc's Scrap Pile

George Woloch Co., Inc., New York, N. Y., recently purchased the entire stockpile of scrap rubber from Pequanoc Rubber Co., subsidiary of American Hard Rubber Co. Considered to be one of the largest transactions in scrap rubber, this procurement consisted of 18 million pounds of scrap rubber.

Included in the transaction were several thousand tons of tires as well as miscellaneous grades. George Woloch Co., Inc., a broker in scrap rubber and a dealer in this material, is currently offering this material to various reclaimers throughout the world.

To Supply Styrene To Seamco Chemical Co.

Signing of a basic contract to convert styrene produced at El Paso Natural Gas Products Co.'s new plant near Odessa, Tex., into a primary material used in making plastics has been jointly announced by El Paso Natural Gas and the Rexall Drug Co., Los Angeles, Calif. Under the agreement, El Paso Natural Gas will supply styrene to Seamco Chemical Co., a division of the Rexall subsidiary, Seamless Rubber Co., at its plant at Holyoke, Mass., center of the New England plastic molding industry.

Seamless Rubber, through its chemical division, Seamco, will convert the styrene into polystyrene, a plastic material, used extensively in molding products into industrial and domestic goods. Produced in liquid form the styrene would be shipped by rail from Odessa to Holyoke.

According to the announcement, Rexall's Seamco Chemical Co. and El Paso Natural Gas Products Co. also will jointly participate in an extensive research program aimed at developing new and improved plastics. A research laboratory will be constructed at Holyoke for this purpose.

One of the newest and most advanced of its kind, Seamco Chemical Co.'s Holyoke plant is a significant factor in Rexall's current program of expansion and diversification. Seamco does not mold its own polystyrene into plastic goods, but sells its entire output to manufacturing firms.

The styrene plant at Odessa, now under construction, is scheduled for completion by early spring. Capacity of the plant is 40 million pounds a year.

Styrene produced at Odessa also will be utilized by The General Tire & Rubber Co. in the manufacture of synthetic rubber at its nearby plant.

Stauffer-Aerojet Co., New Partnership

Aerojet-General Corp., Azusa, Calif., a subsidiary of The General Tire & Rubber Co., and Stauffer Chemical Co., New York, N. Y., have announced a joint partnership agreement under which they will develop and produce boron compounds, expected to be used widely as fuels for rockets, missile and airplane propulsion. The partnership will be known as the Stauffer-Aerojet Co. The business of the company, conducted principally at Azusa, will be research and development of suitable methods of manufacturing high-energy fuels and other work required to be performed under contracts executed by the joint venture with the Federal Government and such other work as the partners may from time to time mutually agree upon.

FWD Teracruzer tows fuel train

FWD Fluid Transporter Uses Goodyear Containers

The new FWD fluid transporter, utilizing containers developed by The Goodyear Tire & Rubber Co., Akron, O., has been unveiled at Clintonville, Wis., for officials of the Army, Navy, Air Force, Marine Corps, and industry. The transporters developed for the U. S. Army Transportation Corps by the Four Wheel Drive Auto Co. has 10 fluid carriers, each five feet high, 3½ feet wide, and with 500-gallon capacity, mounted in pairs on FWD-developed axle and towing assemblies equipped with filling and emptying and braking systems.

The Goodyear containers are mounted on tubular axles with wheel bearings and hub and rim mounting that allows easy removal or replacement of empty tire bags. The air-over-hydraulic brakes of the transporter assemblies are operated from the towing vehicle.

Individual manpower can be used to maneuver single transporters for short distances over level ground. The FWD-designed system empties or fills each container at a rate of 50 to 100 gallons a minute, and there is also a filtering system for direct pumping of aviation fuels. Fully loaded, single tank units were dropped from a five-foot height without any damage during demonstrations.

The Goodyear tire bags require no maintenance, and the FWD towing assembly and frame need only periodic greasing of axle bearings and the usual periodic brake inspection. The tires and assemblies have resistance to a range of chemicals and fuels of up to 40% aromatic content for specific applications and can be stored outside in temperatures as low as —80 or as high as 160° F. They can be operated in temperatures of —65 to +125° F.

The rubber containers of the FWD fluid transporters are similar to the low-pressure (3-15 psi.) Goodyear Terra-Tires utilized on FWD's famed Teracruzers, which are being used as multi-purpose trucks in the ground support and launching system of the Matador guided missile.

U. S. Rubber Opens Branch in Miami

United States Rubber Co., New York, N. Y., has formally opened a new branch for its footwear and general products division in the metropolitan Miami area to expand its service to Florida, one of America's most rapidly growing markets. The modern, one-story, brick and steel structure is located on a two-acre site in the city's outskirts at 6001 Northwest 37th Ave. in Dade County. This new branch has 19,500 square feet of office and warehouse space and will serve all but the extreme western section of the state.

It is the rubber company's first branch in the Miami area, and second in Florida. Its branch in Jacksonville deals principally in tires.

The sales force of the new branch will handle Keds, Kedettes, waterproof footwear, waterproof clothing, sports footwear, sports clothing, Koylon foam rubber mattresses and foundations, U. S. Rug Underlay and U. S. Royal golf balls. Several of the products will also be warehoused.

The branch has 16,500 square feet of warehouse space with 17-foot ceilings in the warehouse area for efficient stack storage. It also has a five-truck loading platform, and a one-car loading dock for rail shipments, served by a private spur of the Seaboard Railroad.

Ralph D. Wheeler is the district sales manager; William C. McCloskey, branch operating manager; and R. M. Turner, branch credit manager.

Plan Consultant Firm

F. L. Kilbourne, Jr., has announced his association with Henry H. Homeyer, Jr., serving the rubber industry as consultants. The firm name will be Homeyer-Kilbourne, Consultants, address Center Road, Woodbridge, Conn. (Fulton 7-6739).

Homeyer has been consulting in the rubber, chemical, and plastics fields since December, 1954. He has had 17 years' experience in product and process development and equipment design and holds numerous patents in the pressure-sensitive tape field.

Dr. Kilbourne has had 28 years' experience largely in the fields of reclaiming rubber and compounding silicone rubber. He has published numerous scientific articles and holds patents in the fields of rubber accelerators, reclaiming rubber processes, rubber derivatives, vulcanization, processing of silicone rubber, O-ring seals and pressure-sensitive adhesives.

The new firm offers a complete service ranging from counseling on research and development programs, through actual development of products or processes, to design of factory equipment and assistance in finding markets for new products. Customers' interests will be protected by observance of a rule that only one customer in any given line of products will be accepted.

Richardson Pilot Plant

The Richardson Co. has broken ground for the construction of a chemical pilot plant adjacent to its general offices and laboratories in Melrose Park, Ill. Completion is expected late this spring.

Marking its one hundredth anniversary in 1958, The Richardson Co. is a leader in the manufacture of automotive battery parts, industrial laminated plastics in sheet, rod, and tube forms, and a varied line of thermoplastic and thermoset plastics. Present operations in six plants consist of the manufacture of synthetic resins, the formulation and compounding of asphaltic, rubber, and plastic compositions, and the fabrication of products for the automotive, aircraft, electrical electronics, communications, and chemical processing industries.

Richardson products, such as the asphalt based battery containers and thin walled high-impact battery containers, copper clad insulating boards for printed circuits used in the electronics industry, and gears and pulleys fabricated from molded laminates, have been based on internally developed technology. Existing laboratory and pilot facilities are used for the development of products of this type.

The new chemical pilot plant is planned to meet the need of facilities for conducting advanced process research and process development on chemical processes for new products arising from the company's expanded research program. To be provided with prototype equipment representing usual unit operations, the facility is expected to have sufficient flexibilty to serve as a general-purpose unit for chemical engineering studies.

A section of the building will be isolated and specially constructed for the installation of pressure equipment, and another section will be provided for office and control laboratory space.

NEWS BRIEFS

Hercules Powder Co., Wilmington, Del., has established Detroit as headquarters of a new synthetics department sales district and has appointed E. S. Massey as branch office sales manager. This move points up the importance of this industrial area as a consumer of synthetic resins, pentaerythritol, and other chemicals sold by the firm. The principal territory served by the Detroit office will include the southern peninsula of Michigan and Lucas County, Ohio.

M. O'Brien & Co., Ltd., Christchurch, New Zealand, has become the second company in that country to affiliate with Wellco-Ro-Search of Waynesville, N. C. O'Brien recently concluded negotiations for the use of Ro-Search's patented "Process 82" for vulcanization of rubber soles to prewelted leather uppers. The New Zealand firm plans an initial production in the new process of 500 pairs of workboots per day. Marathon Rubber Co., also of Christchurch, is affiliated with Wellco-Ro-Search for the manufacture of other types of footwear on other Ro-Search patented processes.

Wyandotte Chemicals Corp.'s new oxide products plant, under construction in the last eight months at the company's North Works in Wyandotte, Mich., has gone on stream and is approaching rated capacity. The new unit more than doubles the company's production of a wide range of ethylene oxide and propylene oxide derivatives. The new multi-purpose oxide products plant will enable the company to meet the rapidly rising demand for Wyandotte Pluronic and Tetronic polyethers. Urethane grades of polyols, developed within the last year as basic components in the whole field of polyurethane foams, have also accounted for appreciable volume.

Division of High-Polymer Physics, American Physical Society, will hold its eighteenth meeting at the University of Chicago, Chicago, Ill., on March 27, 28, and 29, jointly with the meeting of the parent Society. The program is being arranged by a committee headed by Prof. E. R. Fitzgerald, Department of Physics, Pennsylvania State University, University Park, Pa.

Hooker Electrochemical Co., Durez Plastics Division, North Tonawanda, N. Y., has opened an additional district sales office at Kenton, O., the location of its highly automated branch molding compounds plant which began production in 1955. George A. Shroyer has been named district manager for the area including Ohio, Michigan, and parts of Indiana, Pennsylvania, Kentucky, and Tennessee. The Durez office in Detroit, now to be managed by Kenneth J. Fuoco, becomes a branch office in the district. Products handled by the two offices are phenolic, polyester, and diallylphthalate molding compounds, industrial resins, and Hetron flame-retardant polyester resins.

The Rubber Trade 30-Year Club, New York, N. Y., held its Christmas party at the New York Athletic Club on December 10. The 30-Year Club is made up of a group of owners, stockholders, traders, buyers, and sellers, in short that group which is the heart of the rubber import business. Besides regular gatherings through the year, the club holds a Christmas party, at which time each member brings a son, protege, or someone affiliated with the rubber import industry.

The Borden Co., Chemical Division, the name adopted in 1948, for the chemical business of that company, has been given a new name, The Borden Chemical Co., division of the Borden Co., New York, N. Y. Borden's manufactures include formaldehyde, polyvinyl chloride, and other resins and plastics, as well as many specialized products for the paper, textile, and paint industries.

The Goodyear Tire & Rubber Co., Akron, O., has built to the specifications of Delaware River pilots a rubber fender designed to encircle the edge of the deck of an all-steel pilot boat which has been put into service at Lewes, Del., home port for the pilots. The new vessel, called the *Brandwine,* is equipped with the rubber bumper to absorb collision shocks. The rubber fender is cylindrical, has an outside diameter of eight inches, and a three-inch hole in the middle to soak up shocks. There is no need of additional rope or rubber tire fendering.

Diamond Alkali Co., Cleveland, O., has developed six promising new chlorinated compounds utilizing p-xylene as the basic raw material. They are now available in semi-commercial quantities for use by other chemical manufacturers and the chemical process industries. Three of these new products are ring chlorinated compounds; while the remaining three are chain chlorinated. The former are identified as 2-chloro-p-xylene, 2,5-dichloro-p-xylene, and 2,3,5,6-tetrachloro-p-xylene; the latter compounds, which exhibit greater chemical activity, are a-chloro-p-xylene, a,a′-dichloro-p-xylene, and a,a′-hexachloro-p-xylene.

Minnesota Rubber & Gasket Co., Minneapolis, Minn., has changed its corporate name to Minnesota Rubber Co. and completed a realinement of the company's five subsidiaries. In the divisional reorganization, Minnesota Silicone Rubber Co., manufacturer of silicone rubber parts, is now silicone rubber division of Minnesota Rubber Co.; Minnesota Latex Rubber Co., producer of dipped, molded, and formed rubber and plastic products, has become plastics and latex division; while Minnesota Rainbow Rubber Co., manufacturer of colored rubber parts, is now Rainbow rubber division.

Monsanto Chemical Co.'s organic chemicals division has established new district sales offices at Minneapolis, Minn., Pittsburgh, Pa., and Syracuse, N. Y. The creation of these three new offices reflects Monsanto's expanding sales volume in those areas and a confidence in continuing sales growth with the help of complete district sales service. Arthur A. Hibbeler has been appointed district sales manager at Minneapolis; James D. Wright has been named district sales manager at Pittsburgh; and Roy P. Sullivan, Jr., district sales manager at Syracuse.

Beebe Rubber Co., Nashua, N. H., is adding a new addition of more than 10,000 square feet to its main plant. The increase was made necessary by the heavy rise in the popularity of Ripple Soles, as well as soling slabs, heels, and related products. Leading shoe manufacturers are making heavy sampling and tests on the company's premolded Anchor Sole.

E. I. du Pont de Nemours & Co., Inc., Grasselli chemicals department, has announced the addition of dimethylamine dilution facilities at its Cleveland, O., plant. Shipments of dimethylamine in aqueous solution will be made from that point. Industrially, derivatives of dimethylamine are used as surface active agents and in the production of synthetic resins, pharmaceuticals, dyes, photographic developers, and rubber accelerators.

The Dow Chemical Co., Midland, Mich., has announced price reductions on its Versene chelating agents which perform a variety of metal ion control functions for the textile, rubber, and compounding industries. Effective January 1, reductions on certain chelating agents will be as much as 20%.

Firestone Tire & Rubber Co. of Canada, Ltd., Hamilton, Ont., has put into operation at its Hamilton plant a battery of new tire presses. The most modern automatic presses available, these machines were installed as part of the company's current expansion and modernization program, which also includes a new warehouse addition now nearing completion at Hamilton.

Monsanto Chemical Co., St. Louis, Mo., has completed at its general headquarters installation of a large-scale analog computer system for solving complex mathematical equations at its research and engineering division. This computer will be operated by the systems section of the research and engineering division's engineering department. The machine is expected to be a valuable tool in helping solve the complex mathematical equations arising from Monsanto's study of automatic control systems for its chemical plants.

Parker Rubber Division, Parker-Hannifin Corp., Cleveland, O., has announced a silicone rubber compound, number 85-138, as a new material for O-rings and custom molded parts for high-temperature sealing applications. Concocted by the Parker rubber research and development laboratory, the compound is recommended for use at temperatures as high as 600° F. for short periods of time. It has Shore A hardness of 50, about 800 psi. tensile strength, and elongation of about 250%. Compression set after 24 hours at 450° F. is approximately 25% by thickness.

Erie Foundry Co., Erie, Pa., manufacturer of presses for the rubber and plastic industries, has developed a new mechanical forging press with features never before combined in a single piece of forging equipment. On the press, ram guiding has been improved by auxiliary guides provided at the bottom of the stroke by the application of a guiding principle. Features of the new press include more working room at the press; circulating flood lubrication for the main bearings; Scotch yoke operated in an oil bath; and a brake on the mechanical forging press which is adjustable from the floor. The 2,500-ton press is said to offer greater work manipulation clearance and to permit the operator to be closer to his work with greater safety.

Hooker Electrochemical Co.'s Durez Plastics Division, North Tonawanda, N. Y., has announced availability in commercial quantities of Hetrolac 105, a transparent lacquer for coating glass-reinforced polyester corrugated or flat plastic panels to inhibit discoloration and other degradation caused by exposure to weather and sunlight. Severe and lengthy exposure tests are reported to have proved the effectiveness of the lacquer.

Oakite Products, Inc., New York, N. Y., has established two new divisions in its nationwide field organization. Rochester, N. Y., will be the headquarters of the new Upper New York State division, and the new mid-south division will consist of Oakite representatives in Cincinnati, Nashville, Louisville, Knoxville, Evansville, Little Rock, Jackson, Memphis, Shreveport, and New Orleans. The new divisions became operative on January 2.

E. I. du Pont de Nemours & Co., Inc., will build three new production units for the manufacture of hydrogen and anhydrous ammonia, aniline, and diphenylamine at its Repauno works, Gibbstown, N. J. The new facilities for aniline and diphenylamine will modernize the company's present process for these two products by replacing obsolete equipment. The unit for hydrogen and anhydrous ammonia will be the first one at the Repauno works. Construction will begin immediately, and the units, to be operated by the company's explosives department, are expected to be completed within two years.

B. F. Goodrich Aviation Products Co., Troy, O., has announced a new heavy-duty, full-circle brake or off-the-road equipment. Named the Hi-Torque, it is said to be the first hydraulic drum-type brake with 360-degree expander tube actuation designed exclusively for large tractors, scrapers, and earthmovers. The Hi-Torque is claimed to be unusually simple and easy to service. It requires no lubrication, eliminates mechanical shaft or cam alinement problems, and can be disassembled with only standard handtools. Lining changes are accomplished with only a screw driver and mallet.

Howard Ehmke Co. has manufactured a new neoprene-covered nylon cover for protection of the field at Connie Mack Stadium, home of the Philadelphia National League Baseball Club. According to the Aldan Rubber Co., Philadelphia, Pa., the principal feature of the cover is its durability. The neoprene-coated fabric is said to be stronger, unaffected by sun exposure, oil resistant, mildewproof, and able to withstand temperature of —40° F.

Witco Chemical Co., New York, N. Y., plans construction of a phthalic anhydride plant in Chicago, Ill. The plant will be designed and constructed for Witco by the Scientific Design Co., Inc., for an annual capacity of 20 million pounds of high-quality phthalic anhydride. The plant will be in Chicago's Clearing district, adjacent to one of the 38-year-old company's present chemical manufacturing plants. Completion date has been schduled for early 1959. The new product will be sold through Witco's organic chemical division.

Olin Mathieson Chemical Corp., organic chemicals division, New York, N. Y., has added a 98% ethylene diamine to its organic line as a result of the desire of consumers for a more concentrated product. Moreover 85-88% and 90-93% of ethylene diamine will continue to be produced. Principal users are makers of textile finishing and polyamine resins, synthetic waxes, rubber chemicals, fungicides, pharmaceuticals, and chelating agents.

Morningstar, Nicol, Inc., New York, N. Y., producer of starch and chemical products for the paper, textile, food, packaging, pharmaceutical, and cosmetic industries, and its principal industrial adhesives manufacturing subsidiary, Paisley Products, Inc., has been merged to form a single corporation, Morningstar-Paisley, Inc., effective January 1. The new corporation name emphasizes the two major segments of the organization: Morningstar, with its starches, water soluble gums, and dextrines; and Paisley, one of the larger manufacturers of packaging adhesives, polyvinyl acetate, latex, and plastisol products.

Rubba, Inc., New York, N. Y., has developed a new adhesive Rubbaweld, said to be excellent for bonding rubber and fabric to metal. Rubbaweld is also good for bonding plastic and rubber to metal. The adhesive is said to provide a flexible shock-resistant bond which is impervious to most oils, acids, and alkalies. Rubbaweld is self-curing and does not require heat, catalyst, or accelerator. Rubbaweld, a one-part adhesive, can be applied by brush or coating machine.

Invincible Industries, a subsidiary of J. W. Jagger & Co., Ltd., one of the largest enterprises on the African continent, has become the second firm in the Union of South Africa to affiliate with Wellco-Ro-Search, Waynesville, N. C. The firm has licensed Ro-Search's patented "Process 82" and technical assistance in producing such footwear. Initial production in this process is scheduled to be 1,000 pairs per day at the Capetown, South Africa, factory.

NEWS about PEOPLE

Petroleum Chemicals, Inc., New Orleans, La. has completed a pipeline from its Lake Charles manufacturing plant to two contract customers in Orange, Tex. The interstate pipeline will transport high-purity ethylene to E. I. du Pont de Nemours & Co., Inc., and the Spencer Chemical Co. P. C. I. is presently completing a plant capable of producing 200 million pounds of ethylene annually.

International Latex Corp., chemical division, has appointed Latex & Rubber, Inc., 1075 Hull St., Baltimore, Md., as its sales representative for Tylac latices for New York, New Jersey, Pennsylvania, Maryland, Delaware, and portions of Virginia.

The Goodyear Tire & Rubber Co., chemical division, Akron, O., reports that a combination of Chemigum Latex 245 and Pliovic Latex 300, the latter a PVC copolymer latex, has been found by Sanitary Laundry & Dry Cleaners, San Francisco, Calif., to be particularly effective for rug backing. As a backsizing material, it is reported to provide important anti-skid properties and increases overall service life of the rug.

Research Specialties Co., Berkeley, Calif., has announced that its laboratories are now synthesizing a crystalline, alkali-free, potassium cyanide-C^{14} This compound replaces the less highly purified product at no increase in cost. The company produces a variety of C^{14}-labeled radiochemicals.

Miner Rubber Co., Ltd., Granby, P. Q., Canada, and Peters Mfg. Co., Wollaston, Mass., have announced an agreement whereby Miner will make all types of cable tape for the wire and cable industry of Canada. Peters, founded in 1898 and a leader in the tape industry in the United States, will supply the technical service.

The Wooster Rubber Co., Wooster, O., one of the top five in the United States housewares industry, recently announced a corporate name change to Rubbermaid, Inc. The company will keep its main headquarters and operating facilities in Wooster, even though the name Wooster will disappear from the company's title. Rubbermaid, Inc., operates its main factory at Wooster, and the bulk of the 1,200-person employee group is also located there. Subsidiary companies are in Cleveland, O., Jamestown, N. Y., and Cooksville, Ont.

S. T. Rose has been named group sales manager, and **H. L. Hollingsworth,** staff engineer, of the plastics, wire and cable, instruments, and foundry group, The Electric Auto-Lite Co., Toledo, O.

Haddad Studio

Newton H. Tuthill

C. H. Smith

C. H. Smith has been transferred from the Philadelphia to the Minneapolis field office of the Goodyear Tire & Rubber Co.'s chemical division. As a special representative, Smith will provide sales and technical service for all products marketed by the Goodyear chemical division. These include synthetic rubbers, resins, and latices supplied to the rubber, plastics, paint, and textile industries.

Newton H. Tuthill, vice president and general manager, has been appointed president of American Hard Rubber Co., a division of Amerace Corp., New York, N. Y. He will continue to hold the position of general manager of American, which he joined in 1937. He was previously executive vice president and general manager of Pequanoc Rubber Co., another unit of Amerace.

R. S. Wilson, executive vice president and veteran sales head of The Goodyear Tire & Rubber Co., Akron, O., retired as of February 1, and **Victor Holt, Jr.,** vice president and tire sales manager, has succeeded to the title of vice president in charge of sales. Holt also replaces Wilson as a member of the policy committee and has been elected to the board of directors of the company. Wilson's retirement comes after 45 years of Goodyear service. For 30 of these years he was sales head of the company.

Lawrence Flett, consultant, National Aniline Division, Allied Chemical & Dye Corp., New York, N. Y., has been unanimously chosen to receive the 1958 Gold Medal of the American Institute of Chemists. Presentation will be made during the AIC annual meeting, April 10-11, at the Ambassador Hotel, Los Angeles, Calif. The American Institute of Chemists is a national organization founded in 1923 to improve the professional status of chemists and chemical engineers.

E. Thomas Oakes has been elected president by the board of directors of E. T. Oakes Corp., Islip, N. Y. He succeeds **E. T. Oakes,** who recently succumbed to injuries received in an accident in Mexico.

Dean E. Bluman has joined the B. F. Goodrich Research Center, Parma, O., as a technical man. **Nicholas M. Trivisonno** has joined the B. F. Goodrich Research Center, Brecksville, O., as a senior technical man.

Henry L. Ford

Henry L. Ford has ben elected a vice president, and **W. Chamberlain Hale** an assistant vice president of Tennessee Eastman Co., Kingsport, Tenn. Ford was formerly a vice president of Eastman Chemical Products, Inc., and headed the chemicals division of this Kodak marketing subsidiary for products manufactured by the Tennessee and Texas Eastman divisions. Hale was previously the superintendent of production planning and a director of Tennessee Eastman. **Spencer E. Palmer** has been elected first vice president of Eastman Chemical Products, Inc.; **R. S. Leonard** has been named assistant vice president; while **R. L. Flanary** succeeds him as comptroller.

Robert E. Barrett has joined the staff of Copolymer Rubber & Chemical Corp., Baton Rouge, La., as a research chemist. He was previously with Battelle Memorial Institute, where he was employed from 1952 to 1957. **Albert H. Hart, Jr.,** has joined the staff of Copolymer as a chemist in the development division. He was previously with Monsanto Chemical Co. and the U. S. Army Chemical Corps. **J. Robert Olechowski** has joined the Copolymer staff as a research chemist. He is currently finishing work for his Ph.D. at Louisiana State University.

Harry A. Russell has been elected vice president of The Pantasote Co., Passaic, N. J. Mr. Russell, who has been technical director, joined the company in 1942. He will be in charge of research and development at the company's plant in Passaic and of its divisional plant, The Eleonora Chemical Corp. The parent company manufactures vinyl film and sheeting for draperies and tablecloths and also manufactures coated fabrics; the subsidiary division produces PVC resin.

Glenn C. Vickery has been appointed chemical sales representative for The General Tire & Rubber Co., Akron, O. Headquartering in New York, N. Y., he will cover the Middle Atlantic States.

B. D. Thomas, scientist and research administrator, has been named to the presidency of Battelle Memorial Institute, Columbus, O., to succeed **Clyde Williams,** whose retirement as president was recently announced.

Walter T. Johnson has been named assistant vice president in charge of sales, Seiberling Rubber Co., Akron, O., a newly created post in which he will devote his full time to building tire distribution in new markets. **Jack A. Fouche** was named sales manager to succeed Johnson, who held the position since 1953. **Orrin K. Feikert,** truck tire sales manager, succeeds Fouche as assistant sales manager.

Walter T. Johnson

Harry A. Russell

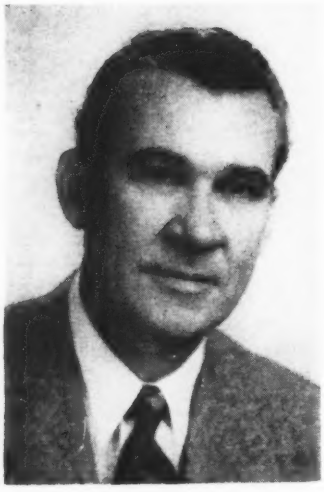
Alan W. Bryant

Alan W. Bryant has been appointed assistant sales manager for Mapico colors in the carbon black and pigments division, Columbian Carbon Co. He formerly was eastern district sales manager. He will continue in Columbian's general offices at 380 Madison Ave., New York. He succeeds **John T. Kealy,** who becomes sales consultant to the Mapico color unit.

T. H. Glynn Michael recently was appointed general manager and secretary of The Chemical Institute of Canada, Ottawa, Ont. He was formerly director of research, Howards & Sons (Canada), Ltd., Cornwall, Ont. He replaces **Garnet T. Page,** now with The Engineering Institute of Canada in Montreal. As general manager, Mr. Michael will serve as executive officer of the Institute under the direction of the board of directors. He will also serve as managing editor of the C. I. C. publications, *Chemistry in Canada* and *The Canadian Journal of Chemical Engineering.*

William T. Hepburn, manager of passenger tire sales for The Firestone Tire & Rubber Co., Akron, O., has been named manager of the manufacturers sales division. He succeeds **Arthur N. Stuart,** recently named sales manager in the manufacturers sales department. **George G. Eckel,** Firestone sales promotion manager, will succeed Hepburn as manager of passenger tire sales and will report to **E. B. Hathaway,** vice president in charge of trade sales.

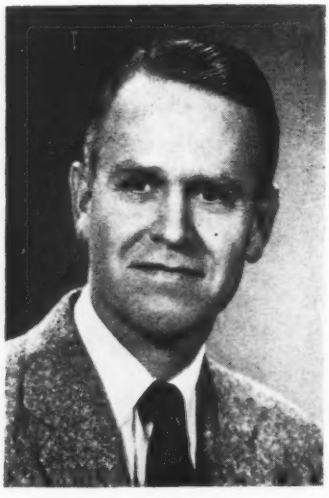
Robert S. Buffum has joined the Borden Co.'s chemical division as a project engineer in the Polyco-Monomer department. He will be stationed at Leominster, Mass., the department's engineering headquarters.



N. L. Heffron

N. L. Heffron, district manager of Pure Carbonic Co.'s Newark district, has been appointed regional sales manager of the northeastern region. This region covers nine states from New Jersey to Maine, and Heffron will be responsible for all the direct selling activities in this area. Pure Carbonic Co., a division of Air Reduction Co., Inc., is a major producer of carbon dioxide in liquid, gaseous, and solid forms for wide applications in industry.

L. S. Hilton, assistant sales manager, has been made sales manager of abrasive and diamond wheel departments, Manhattan Rubber Division, Raybestos-Manhattan, Inc., Passaic, N. J. He succeeds **W. H. Steinberg,** who is now technical consultant, giving most of his time to the development and sale of cut-off wheels, on which he is an authority.



Robert D. Hawkins

James A. Wold has been named general manager of the Borden Chemical Co.'s Resinite department. He succeeds **Grant C. Ehrlich,** who will concentrate his efforts on research and new product development in connection with polyvinyl chloride resins manufactured by the company. Wold will also continue as general manager for the consumer products department, which he has headed since it was created last year. As general manager of the Resinite department, Wold will have charge of extrusion facilities located at Santa Barbara, Calif., and North Andover, Mass.

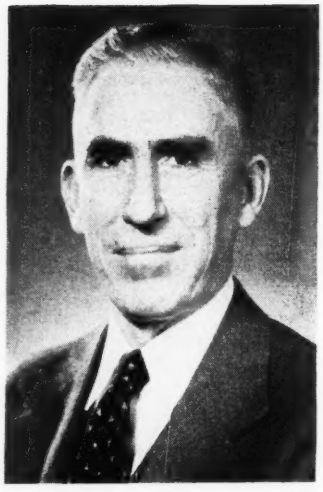
Robert N. Wolfe has been named general manufacturing manager, adhesives, coatings, and sealers division, Minnesota Mining & Mfg. Co., Minneapolis, Minn. At the same time 3M announced the appointment of **Walter C. O'Leary** as technical director for the division, reporting directly to Wolfe, whose new responsibilities include research, product development, technical service, field service, and manufacturing development, as well as the direction of all manufacturing plants of the division.

Bert S. Taylor, vice president of the FMC organic chemicals division of Food Machinery & Chemical Corp., New York, N. Y., has been named director of marketing and purchasing. He will be responsible for all sales and purchasing activities for the division and will make his headquarters in New York, N. Y. He was manager of the development department of Ohio-Apex Chemical Co., Nitro, W. Va., on its acquisition by Food Machinery & Chemical Corp. in 1951.

Richard L. Miller, patent counsel, and **Robert E. Sheldon,** assistant general counsel for the Goodyear Tire & Rubber Co., Akron, O., were elected assistant secretaries of the company at a recent directors' meeting.

Budd E. Pollak has been appointed president, and **Richard P. Houlihan,** vice president, Gavitt Wire & Cable Co., division of Amerace Corp. Gavitt's executive offices are at Brookfield, Mass. Plants are located in Brookfield and West Brookfield, Mass., and at Escondido, Calif.

Robert D. Hawkins has been advanced to assistant factory manager, Republic Rubber Division, Lee Rubber & Tire Corp., Youngstown, O. He will report to **R. W. Deemer,** factory manager, and will assist him in all phases of the Division's belting, hose, packing, and molded and extruded rubber products. Hawkins, with Republic since 1936, has held numerous production positions, most recently (since 1952) as manager, long hose department.

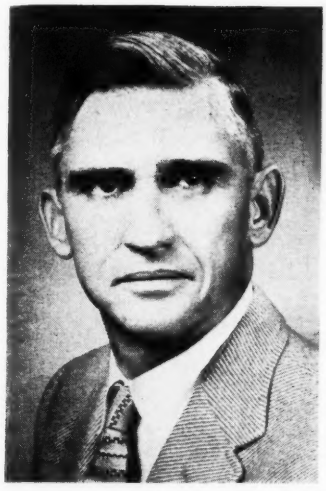


Robert A. Merrill

Robert A. Merrill has been named assistant director of tire development, United States Rubber Co., with headquarters at Detroit, Mich. Dr. Merrill was formerly assistant tire production manager and had been manager of process development and assistant manager of the Detroit and Chicopee Falls, Mass., tire plants.

Ralph T. Hickcox has been named technical director of the Oliver Tire & Rubber Co., Oakland, Calif. Hickcox, formerly West Coast manager of Goodyear's chemical division, is also well known in the paint, paper, textile, and ink industries on the Pacific Coast. Filling a new position occasioned by the growth of the company and the recent promotion of Russell D. Kettering, who became manager of manufacturing, Hickcox will direct the expansion of research and development in the company and its subsidiaries.

Ralph T. Hickcox



Richard H. Dorsett

Richard H. Dorsett has joined the sales staff of the Witco Chemical Co., New York, N. Y. Dorsett, who will make his headquarters in Dallas, Tex., is attached to Witco's Houston sales office. He will handle products of the Emulsol division as well as organic chemicals and rubber chemicals division materials. Formerly Dorsett worked in the sales department of the plant food division of Olin Mathieson Chemical Co.

Charles W. Selover has been named manager of purchases for Hooker Electrochemical Co. plants at Niagara Falls and North Tonawanda, N. Y. Selover was purchasing agent for raw materials at Hooker since February, 1956, when he was transferred to Niagara Falls from the Durez Plastics division, following the merger of Durez into Hooker the previous year.

George J. Piaskowy

Jack Arnold, Jr., has been appointed supervisor of the Boston, Mass., office, Enjay Co., Inc., 135 Clarendon St. He has been filling this position on a rotational basis since April, 1957.

S. R. Zimmerman, Jr., has been made general manager of the U. S. Asbestos-Grey Rock division, Manheim, Pa., of Raybestos-Manhattan, Inc. Zimmerman has been with the division for the past 25 years, recently as assistant general manager. He is also a vice president and director of Raybestos-Manhattan. **O. H. Cilley,** whom Zimmerman succeeds, continues as a vice president and director of the corporation and also in an advisory and consulting capacity.

Harry R. Cote has been appointed special representative for Plaskon polyester resins for Barrett Division, Allied Chemical & Dye Corp., New York, N. Y. In his new position he will coordinate development, technical service, advertising, and sales of polyester for urethane, premix, and other reinforced plastics applications. Formerly a sales representative for industrial resins in the Buffalo-Pittsburgh-Cleveland area, he is succeded by **Ralph W. Burdeshaw.**

George P. Smith has been appointed personnel manager of the Henry (Ill.) General Chemicals plant of B. F. Goodrich Chemical Co. He was formerly personnel manager of the Salem, Ind., plant of B. F. Goodrich Industrial Products Co.

Russell C. Henderson has been promoted from treasurer to vice president, Yale Rubber Co., Sandusky, Mich. He will also retain his duties of treasurer. **Edward Bielski,** formerly production manager, was promoted to factory superintendent. He joined Yale Rubber in 1945 from General Motors Corp.

George J. Piaskowy has joined The C. P. Hall Co. of Illinois, Chicago, Ill. as sales representative. He will handle the sales of rubber chemicals in Indiana, Illinois, Iowa, Missouri, and Nebraska. He was previously a research chemist at Mystic Adhesives, Inc.

Bernard Willis has joined Velsicol International Corp., C. A., Nassau, Bahamas. He will headquarter in New York, N. Y., and will handle liaison with U. S. suppliers for worldwide distribution. Prior to joining Velsicol, he was with a chemical marketing firm specializing in importing and exporting operations. Velsicol International Corp.'s products include industrial resins and solvents.

Donald L. Johnson

Donald L. Johnson has joined the sales staff of Witco Chemical Co., New York, N. Y., and will serve as a sales representative attached to the company's San Francisco, Calif., office, located at 80 Stonestown. He will be selling products of the organic chemicals and rubber chemical divisions.

Roger C. Corwin and **Donald A. Sayles** recently joined the commercial development staff of The Richardson Co., Melrose Park, Ill. The department recently was organized to identify and develop markets for new plastics products and to assist in diversification planning. Corwin is responsible for market research and new product development of resins, plastics, and chemicals. Sayles is responsible for technical service and market research activities in support of the company's new plastic laminate development programs.

Bernard Willis

News about People

George B. Kelly, Jr., and **Frank D. Heindel** recently joined the development department of Union Carbide Chemicals Co., Division of Union Carbide Corp., South Charleston, W. Va. Prior to joining Carbide, Kelly was a project leader at Westvaco research laboratory. Heindel was associated with the research and development department of Westvaco Chlor-Alkali division for 16 years before joining Carbide.

Jack B. Scarcliff, former West Coast manager of advertising and promotion, has been named sales promotion manager for The Firestone Tire & Rubber Co. in Akron, O. He succeeds **George G. Eckel,** new manager of passenger and race tire sales.

J. Ray Coulter has been appointed manager of manufacturing of American Cyanamid Co.'s industrial chemicals division, New York, N. Y., and will be responsible for the supervision of manufacturing activities of the division's 15 plants, which produce a wide variety of chemicals and chemical intermediates for the paper, petroleum, metal processing, plastics, and other industries.

Louis M. Corcoran has been appointed a vice president in sales, New Jersey Rubber Co., Taunton, Mass., and **Robert Van Patten-Steiger,** a vice president in manufacturing. Mr. Corcoran has been with the company for many years as production manager, whereas Van Patten-Steiger joined the firm in 1957.

E. Kenneth Burger, a chemical market research expert with Esso Standard Oil Co., New York, N. Y., has retired from the company. He was manager of the market analysis division of the chemical products department for the past 12 years. He will, however, be retained as a consultant. Mr. Burger is a past president of the Chemical Market Research Association.

George A. Lescisin has been transferred to the Washington, D. C., office of Union Carbide Chemicals Co., Division of Union Carbide Corp., New York, N. Y. In his new location he will be the technical representative in Washington for the company's development department.

Thomas J. Campbell has been appointed sales manager of the Metasap Chemical Co., a subsidiary of Nopco Chemical Co., Harrison, N. J., and succeeds **O. E. Lohrke.** Campbell, formerly assistant sales manager of Metasap, has a background of 20 years of field and home-office experience with Nopco and Metasap products.

O. B. Schier, II, has been appointed secretary of The American Society of Mechanical Engineers, New York, N. Y., according to J. N. Landis, 1958 president of the 50,000-member group. Schier, designated secretary-elect last June, succeds **C. E. Davies,** who was secretary of ASME for 23 years.

Jack E. Zimmerman, group leader in development for the plastics division of Diamond Alkali Co., Cleveland, O., has been appointed assistant manager of research and development. **Joseph V. Hartman, Jr.,** a technical service representative for the division for the past two and a half years, becomes group leader of the applications section of the plastics research and development laboratory. **Nathan M. Blackman,** associated with the plastics division in charge of the laboratory's pilot-plant section, succeeds Zimmerman. All three men will continue to be located at the Diamond research center, Painesville, O.

Francis C. Kennedy has been appointed manager of tire textile development, United States Rubber Co. He was formerly in charge of off-the-road tire development and has been succeeded in that post by **Carl F. Engstrom,** who will also have charge of farm tire development. The two men will make their headquarters at the company's tire development laboratory in Detroit, Mich.

William Dunlop has been promoted to the central research and development laboratories of The Richardson Co., Melrose Park, Ill., and has assumed new responsibilities in the product development section. He was previously at Richardson's Indianapolis plant.

Joseph J. Catterall

James M. Kyte, Jr., has been elected president of Coated Products, Inc., Bound Brook, N. J. He was formerly general manager and secretary of the firm, which makes specialty pressure-sensitive coatings for diversified industries.

Obituaries

Joseph J. Catterall

Joseph J. Catterall, one of the most widely known trade association executives in the rubber industry, died suddenly of a heart attack at his home in South Orange, N. J., January 18. He had been with The Rubber Manufacturers Association, Inc., New York, N. Y., since 1937.

Joe Catterall, as he was known to his many friends and associates in the rubber industry, was born in Berwick, Pa., in 1903. He attended Bucknell University.

He worked for the American Car & Foundry Co. in Berwick until he was transferred to New York for that firm about 30 years ago.

Joe Catterall joined the RMA in 1937 and was an assistant secretary of that organization at the time of his death. He served as secretary for the following groups in the RMA: Mechanical Goods Division; Management Committee; Industrial Rubber Goods, Latex Foam, Corrugated Matting, O-Ring, Stair Tread, Tape, Thread, and V-Belt subdivisions; and the Hard Rubber Goods Division.

He was a member of the Baltusrol Country Club and the Sons of the American Revolution.

Funeral services were held at the Colonial Home in East Orange, N. J., on January 21.

He is survived by his wife, two stepsons, his mother, a brother, a sister, and seven grandchildren.

John H. Merrell

John H. Merrell, honorary director of Raybestos-Manhattan, Inc., Passaic, N. J., passed away, January 4, at Chicago, Ill. He started with The Manhattan Rubber Mfg. Co., now the Manhattan Rubber Division of Raybestos, in 1903 at the Chicago branch office as manager of the solid carriage tire department. He became successively Chicago branch manager, vice president and a director of Raybestos-Manhattan, Inc.

Mr. Merrell faithfully served the company for 54 years, and his passing is a loss to the company and to his many friends in the automotive, mining, agricultural, steel, and other industries with which he worked closely.

NEWS from ABROAD

Malaya

Rubber Workers Co.

The rubber tappers of Perak are to use up most of their life savings to float Malaya's first labor-owned rubber company, a $3,000,000 undertaking, United Malayan Plantations, Ltd. The new company, registered in Ipoh in December, 1957, was formed on the initiative of 300 workers of the European-owned Jong Landor Estate, in Tapah, following its sale to a Chinese syndicate, which intends to break up the estate into smallholdings.

Research Cess Up

In July, 1956, a team of British experts, headed by Prof. J. E. Blackman, of Oxford University, came to Malaya at the invitation of the Rubber Producers' Council to study means of improving the position of natural rubber in competition with synthetic rubber. The experts handed in a report with their recommendations in the early part of 1957, which did not meet with the unqualified approval of all sections of the rubber planting industry. In particular the recommendation to raise the rubber research cess from 0.5-cent (Straits) to 0.75-cent per pound, to provide increased funds for research, met with some opposition.

Latest news from Malaya, however, indicates a change of heart: the government's decision to increase the cess, as suggested, after February 6, in order to give rapid and vigorous effect to the Blackman recommendations—which the government has largely accepted—has had the full support and cooperation of the industry, we learn. The increase will bring the funds available for rubber research in Malaya to about $10,000,000 (Straits) annually. Ways of cutting costs of production, improving the quality of rubber, eliminating waste and duplication in research work, broadening the scope of the Rubber Research Institute of Malaya, avoiding costly publicity and experiment, to say nothing of avoiding misdirected energy in research in general, were stressed by the Blackman Committee as aims to be achieved.

It now remains for the government and industry to reach an agreement on the organization of research programs and the constitution of directing bodies. The Blackman report suggested that a director and a chairman of the board be nominated by the government, but that both officers be independent of the government as well as of the industry. The inclusion of three independents as members of the board was also recommended.

1957 Price Levels

The situation in Indonesia was largely responsible for the welcome rise in the price of rubber in the latter part of 1957. For a little while, especially after it became known that November imports of rubber—chiefly from Indonesia—had dropped nearly 10,000 tons, or 28.6%, as compared with those for October, 1957, the more optimistic allowed themselves to dream of rubber prices going well over the dollar (Straits) mark by the end of 1957. Actually the closing price in Singapore on December 31, 1957, was 82½ cents.

According to the *Straits Times*, the average price of rubber on the Singapore market in 1957, based on the noon current months' position f.o.b. price, was 88¾ cents per pound, compared with an average of 97⅛ cents in 1956 and $1.13¾ in 1955. The 1957 average was the lowest since 1954, when it was 67 cents. Price range in 1957 was between $1.13¼ early in the year and 74¾ cents on November 12, as against highest and lowest 1956 prices of $1.26¼ and 72¼ cents, respectively. In 1957, however, the market price closed above the dollar level on only seven trading days, compared with 91 days in 1956.

While the average price for rubber during the last quarter of 1957 hovered around the 80-cent limit, the plantation workers' union worried over the likelihood of a cut for the rubber workers, numbering over 300,000. However it became evident that the average price would be safely over the 80-cent limit. If the union eventually was disappointed in its hopes for a rise in price high enough to provide good bargaining points for securing greater benefits for rubber workers, nevertheless it was satisfied that at least there would be no wage cuts, and the existing wage rate would be maintained for another quarter. It will be recalled that wage rates for rubber plantation workers for a given quarter move up or down according to the range of the average price in the preceding quarter.

Indonesia

Rubber Industry Review

For the occasion of the thirteenth meeting of the International Rubber Study Group, held in Java, June, 1957, a pamphlet, "Some Aspects about Rubber in Indonesia," was compiled from material submitted by various rubber planting organizations. At the time the possibility that only a few months later the Indonesian Government would take steps to expel the Dutch and take over their enterprises must have seemed remote indeed. In view of what has meantime actually happened, and in consideration of the extent to which Indonesian prosperity depends on the rubber planting industry, it would seem of special interest to present some of the facts and figures from the pamphlet referred to.

The importance of rubber in the Indonesian economy can hardly be overestimated; a few million people, including smallholders, estate workers, dealers, and others, depend on it for their livelihood, and it is the country's largest earner of foreign currency.

The rubber industry in Indonesia got its start about 1902, when the first rubber plantation was established in Sumatra; four years later Java also took up the new crop. The indigenous population of Sumatra began to show interest in rubber about 1904, when the first smallholdings appeared in Djambi.

By the time World War II had entered the active stage, the estate acreage in Indonesia had risen from 12,500 hectares (hectare equals about 2.47 acres) in 1906 to 636,300 hectares in 1940, but the smallholding area has increased even faster, and is estimated at 1,300,000 hectares, comprising several hundred thousand gardens, most of them tiny plots with only 100-500 trees; the output has grown from a mere 400 tons in 1910, consisting solely of estate rubber, to 545,535 tons in 1940, with more than half the total coming from smallholdings.

Postwar Situation

Under the Japanese occupation, about 15% of the total acreage—including estates as well as smallholdings—was practically destroyed. But despite this damage and the further damage caused in the postwar disturbances, Indonesia's output by 1950 topped that

TABLE 1. PRODUCTION OF RUBBER

(1,000 LONG TONS IN ROUNDED-OFF NUMBERS)

	Indonesia			Malaya		
Year	Estates	Smallholders	Total	Estates	Smallholders	Total
1945	5.0	5.0	10.0	—	8.6	8.6
1946	—	175.0	175.0	173.8	229.9	403.7
1947	12.7	265.2	278.0	360.5	285.8	646.4
1948	101.7	330.6	432.3	403.6	294.6	698.2
1949	169.1	263.9	433.0	400.8	270.7	671.5
1950	175.1	521.3	696.5	376.7	317.3	694.1
1951	222.5	591.9	814.4	328.8	276.6	605.3
1952	294.5	456.0	750.5	341.7	242.5	584.2
1953	304.2	390.3	694.6	341.8	232.6	574.4
1954	282.2	456.5	738.7	343.4	241.0	584.4
1955	261.7	472.1	733.8	352.9	286.2	639.1
1956	258.2	428.5	686.7	353.0	274.3	627.4

of Malaya, hitherto the world's largest producer of natural rubber, and the lead has so far been maintained, as Table 1 shows, though the gap seems to be closing:

This rapid recovery in production, however, is not a measure of the extent of the rehabilitation activity to bring back the rubber acreage to prewar level. In this respect Indonesia admittedly lags behind Malaya, a situation ascribed to discouragement due to unfavorable political, social and economic circumstances, and to the effect of large-volume synthetic rubber production on the price of natural.

To enable producers in Indonesia to sell their rubber at a profit in competition with synthetic rubber and to encourage them to extend their plantings and increase yields, to be able to dispose of the needful foreign currency, and to continue its schemes for raising the living standard of the population, Indonesia must be able to sell her rubber at an adequate price. With a world market price of 33.055¢ (U. S.) per pound, or an average net f.o.b. of 30 dollar cents per pound, for rubber exports now amounting to about 700,000 tons annually, all this can be achieved, we are told. But to obtain the same results with a net average f.o.b. price of 20 dollar cents a pound, Indonesia would have to be able to export 1,100,000 tons annually. At that price level, under existing conditions, it would be impossible to finance the necessary replanting and new planting to attain this result.

Present Production

In 1956, Indonesia accounted for 37% of world rubber output, against 38% in 1955 and 41% in 1954. The value of her rubber exported represented 40% of the total value of all her exports in 1956, as against 46% in 1955, 31% in 1954, 32% in 1953, and 45% in 1952; about 60% of the value of the rubber exports derives from smallholder rubber. Table 2 (in tons) shows where the rubber went to in 1954, 1955, and 1956.

The main qualities exported, in the order of importance, follow:

Smallholder Rubber
Ribbed Smoked Sheet 3, 4 and 5
Thin Brown Crepe 3 and 4
Blankets C and D
Unsmoked Sheet and Slab

Estate Rubber
RSS 1 and 2
Pale Crepe 1 and 2
Thin Brown Crepe 1X, 2X, and 3X
Concentrated Latex

There seems to have been a marked improvement in the quality of smallholder rubber. A chart comparing the grades shipped in 1950 (total 466,000 tons) and in 1955 (465,000 tons) shows 29.8% of the rubber shipped in the former year consisted of Ribbed Smoked Sheets (mainly 3, 4, and 5), against 42.3% in 1955; while remilleds (C, D, and Dark) increased from 16.3 to 37%. At the same time unsmoked sheet went down to 5.2% from 28.4%, and slab to 8.4% from 14.1%. The details for sheet seem to indicate that the tendency is to concentrate on grades 4 and 5, for the increases in sheet took place exclusively in these grades at the cost of RSS 1, 2, and even 3.

Smallholder Rubber

Rubber production has become an essential source of income in large parts of Indonesia, and, especially where the cultivation of food crops has been neglected in favor of rubber, the possession of a rubber garden can be a matter of life or death for many of the smallest owners. It is calculated that the potential output of the estimated 1,300,000 hectares of smallholder rubber is about 600,000 tons a year, but that the amount actually to be expected is about 500,000 tons.

The smallholders are not organized, hence are more or less at the mercy of local dealers and speculators. The government has therefore set up a special office to advise and aid the smallholders in replanting and new planting, in preparing rubber, restoring remilling facilities and smokehouses, improving local trade, and promoting production and selling cooperatives. The Government is also training the personnel to carry out this work. Model sheet installations have been built which are intended to serve as advisory and training centers and later to become cooperative factories.

That there is ample scope for improvement on smallholdings is evident from the fact that especially in the earlier years trees were grown from unselected and often inferior seed, and that only about 1% of the total area is planted with high-grade buddings or clones; 42% of the existing trees were planted before 1925, and 57% during 1925-35, inclusive.

Further plans being studied for smallholders envisage the cultivation of other crops besides rubber, to lessen the dependence on a single crop, as well as long-term credits to enable smallholders to undertake new planting, since so many of them depend exclusively on rubber for their living and could not afford to replant.

The point is made that in attempting to estimate the probable amount of smallholder rubber that will be produced in a given year, it is not only the potential yield of the garden or the availability of labor for larger holdings (important though the labor question is in underpopulated Sumatra and other parts) that must be considered, but other factors also, chiefly

TABLE 2

	Smallholder Rubber			Estate Rubber		
	1954	1955	1956	1954	1955	1956
Netherlands	11,414	13,297	21,052	23,158	24,642	37,180
Britain	30,197	99,446	88,112	11,480	32,162	32,841
West Germany	17,653	11,220	19,623	28,536	23,846	24,876
France	3,940	2,523	2,040	3,970	2,559	2,102
Other Europe	8,736	12,495	13,882	10,742	20,612	18,856
United States	101,939	92,676	99,110	150,865	108,283	103,830
Other America	15,071	74,885	3,514	7,281	25,934	1,718
Africa	—	—	—	182	65	162
Singapore	206,508	141,546	151,758	11,326	4,055	2,569
Japan	6,797	17,748	19,306	7,252	11,246	24,172
Other Asia	93,148	6,417	5,018	9,620	1,834	4,612
Australia and New Zealand	437	—	—	625	222	45

the relation of the cash income of the small operator to the price of consumer goods

Estate Rubber

In Malaya the difference between an estate and a smallholding is a matter of acreage; a plantation of 100 acres and over is an estate; under 100 acres, it is a smallholding. When reference is made to a smallholding in Indonesia, what is really meant is a property held under the special land laws applicable to the indigenous population, and its extent is evidently not involved. Judged by Malayan standards, therefore, the total area of Indonesian properties that would come under the head of estates would be much larger than the area so designated in Indonesian statistics. This difference must be borne in mind when estates in Malaya and Indonesia are compared. Thus in Table 3, the Indonesian yield rates are much more favorable, as compared with those of Malaya, than they would have been if "estates" covered the same thing in both places.

One cannot help noting the decline in Indonesian estate yields per unit area in Table 3, and it may be pertinent to refer here to results of an inquiry started by one of the big experiment stations in August, 1956, to determine the cause of falling yields on a large number of estates in Java and South Sumatra. The conclusion was that the drop in yields was due primarily to careless tapping and unsatisfactory upkeep of the estates. In other words, to lack of discipline among estate laborers, and that the age factor was of secondary importance here.

These are not the only problems worrying planters in Indonesia. Confronted with synthetic rubber competition they are asking: (1) will the new trees with potential yield of 2,000 kgs/ha. reach maturity in time to offset pressure from synthetic rubber? (2) Will the soil be able to support such trees from which 2,000 kilograms per hectare are tapped year after year? Meantime, it is realized that outputs from Java will decline as a result of the removal of low-yielding trees in replanting programs.

In connection with the question of probable outputs, the above pamphlet also draws attention to the fact that postwar extensions of plantings on estates are in the nature of replacements of the acreages lost during and immediately after the war, and that the rate of expansion has dwindled from year to year, until in 1956 it was practically nil, while the present planted estate area is not yet back to the 1939 level.

A special inquiry instituted by the government in 1956 in connection with rejuvenation plans showed that 34% of estate rubber was planted before 1925; 37.26% between 1925 and 1934; 20.85% between 1935-1944; and 7.78% during 1945-1955. Most of the new planting in the last period was done after 1950, and in view of the postwar rejuvenation difficulties this percentage is considered hopeful.

Estate Organizations

Several organizations, government and private, have been formed to serve the rubber industry. The Government Office, known as the Djawatan Perkebunan, seeks to promote estate productivity by mediating labor questions. The Pusat Perkebunan Negara, with headquarters in Djakarta, runs the 20 large government rubber estates, established in different parts of the country, on a commercial basis.

The private organizations formed by the rubber companies include AVROS (East Coast Sumatra Rubber Planters' Association), formed in 1910, and representing 237,185 hectares in 1955; the ALS (General Agricultural Syndicate), formed in 1925, and representing 151,269 hectares; and the South & West Sumatra Association, formed in 1933, and representing 42,483 hectares. The members are of various nationalities, American (U. S.), British, French, Indonesian, Italian, Netherlands, Norwegian, and Swiss, but the British and Netherlands members are in the majority.

Research

Research on productivity is conducted chiefly by the two big experiment stations of the above associations: The Central Association of Experiment Stations (CPV), with main office at Bogor, and the General Experiment Station (APA) of the AVROS. The CPV, financed from a fund raised by a government cess on estate rubber, operates for the benefit of rubber and other estates in Java, West and South Sumatra, and Borneo; while the APA, entirely supported by the members of the AVROS, is devoted to the interests of the estates in northern Sumatra, mostly on the East Coast.

Many of the large rubber companies have their own scientific departments and laboratories and also participate in yield research. There is an institute created by the government in 1952 exclusively for the benefit of the smallholders; finally, there is the Balai Penjelidikan dan Pemakaian Karet (Institute for Rubber Research & Development, referred to as BP&PK), formerly known as INIRO, which itself was an offshoot of the CPV.

To promote the health, growth, and yield of the trees, reduce costs of production, and improve the quality of latex and rubber are the aims of the experiment stations. They have been investigating optimum cultivation conditions, disease problems, soil improvement, multiplication of planting material, tapping systems, and the effect of yield stimulants. Thanks to their efforts, 40% of Java's and 50% of North Sumatra's present rubber areas are planted with selected material; budgrafts have been used for most of the postwar planting. Yield research has been supplemented by studies on ways of increasing operation efficiency, mechanization of cultivation, economical systems of tapping and upkeep, and the use of chemical agents such as weed and tree killers, instead of manpower, all to keep costs down.

The uniformity of essential properties of latex has been the chief problem handled by the chemical departments, and experts have been studying the composition of latex, the biochemical reactions taking place in it, effects of preservation, and means to counteract possible undesirable influences. The technologists are trying to solve the same problem for rubber sheet and crepe by developing new continuous methods of preparation, by coagulation at constant pH, electro coagulation, removal of non-rubber constituents, new drying methods, centralization. Reduction of the percentage of lower grades and improvement of their quality, as well as the preparation of a normal rubber from "skim," the by-product of latex concentration, are being studied.

The BP&PK aims primarily at developing a clean, raw material with scientifically established properties that meets the requirements of consumers and gives a finished article superior to a similar article made from synthetic rubber. To this end, new techniques are constantly being developed; at the same time new uses are explored to increase world consumption of rubber. The institute keeps local manufacturers posted on new goods and new methods, helps them solve their manufacturing problems by appropiate research, and provides data on new processes.

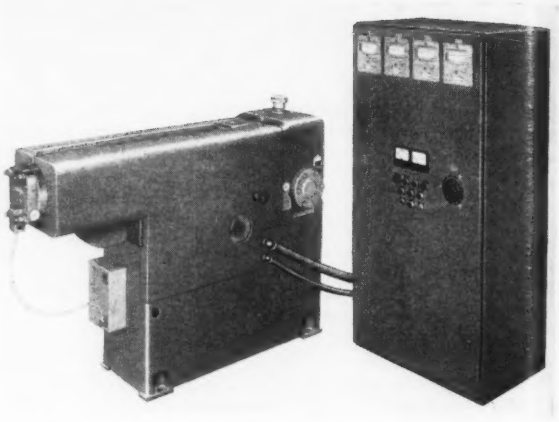
TABLE 3. YIELDS IN KILOGRAMS PER HECTARE ON ESTATES

Year	Malaya	Indonesia
1949	508	835
1950	480	613
1951	418	657
1952	393	722
1953	421	723
1954	425	667
1955	438	621

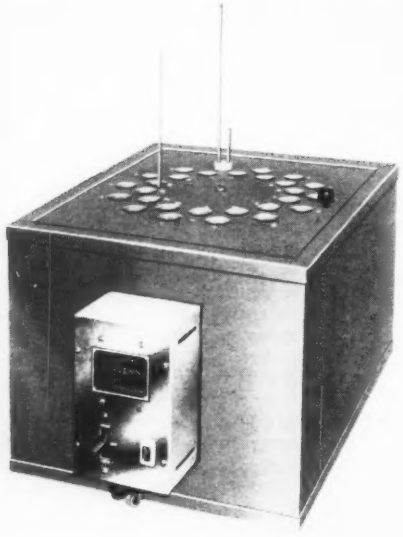
TABLE 4. RUBBER ACREAGE OF ESTATES IN INDONESIA (HECTARES)

1939	1949	1950
603,682	373,731	422,566
1951	1952	1953
461,767	477,936	483,485
1954	1955	1956
486,875	488,494	485,892

NEW EQUIPMENT



NRM 2½-inch Model 55 induction heated extruder



Model LG aluminum block aging tester

New Scott Aging Tester

Scott Testers, Inc., Providence, R. I., has announced a new square design of its 28-hole aluminum aging block, Model LG, first introduced in 1953. Developed by Scott in conjunction with the B. F. Goodrich Research Laboratories and Case Institute of Applied Sciences, this tester has become a standard apparatus in the elastomeric industry for testing in accordance with ASTM Method D 865-54T (Method of Heat Aging Natural and Synthetic Rubbers) and D 471-55T (Method of Test of Change in Properties of Elastomeric Vulcanizates Resulting from Immersion in Liquids) at temperatures up to 600° F.

While the round housing has been the accepted shape, Scott has had several demands for a building-block unit that would snugly occupy a square space in either a corner or a row of companion equipment. In response, its standard LG units are now offered in either round or square exterior at the option of the customer. On special order, the LG, either square or round, is available for temperatures up to 750° F.

Special models, LGH or LGP, up to 1000° F. or for pressure air or oxygen aging are also available.

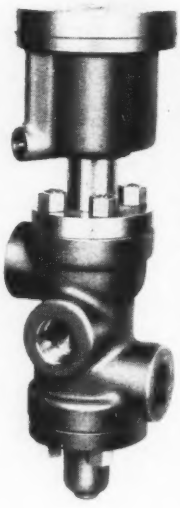
NRM Thermoplastic Extruder

Substantial savings in operating costs, faster response to controls, faster warm-up, and a more precise balance between heat of the extruder and heat of the thermoplastic being processed, are claimed to be special advantages of a new line of electrical induction heated extruders announced by National Rubber Machinery Co., Akron, O.

The NRM system of induction heating causes the necessary extruder operating temperature to originate directly in the cylinder walls, where it is absorbed by the plastic in the cylinder. This method shortens the time interval required by conventionally heated extruders to supply heating or cooling, after controls have called for either. Balanced heat control, an NRM patented method of controlling cylinder heat, is used in conjunction with the new method of supplying heat by the induction principle. The combination makes possible an even more precise balance between heating and cooling, resulting in precision extrusions of finer quality and finish, and more production at lower cost because of reduced "warm-up" time. Since the principle of induction heating requires less energy to operate, substantial savings in kilowatt hours result.

The new equipment is designated NRM 2½-inch Model 55 induction heated extruder. The company has stated that a new line of induction heated extruders will be made available in the standard NRM range of sizes, to meet all extrusion requirements. Requests for more details and to arrange demonstrations should be made to plastics machinery division, National Rubber Machinery Co., Akron, O.

New S-C Control Valves



S-C control valve

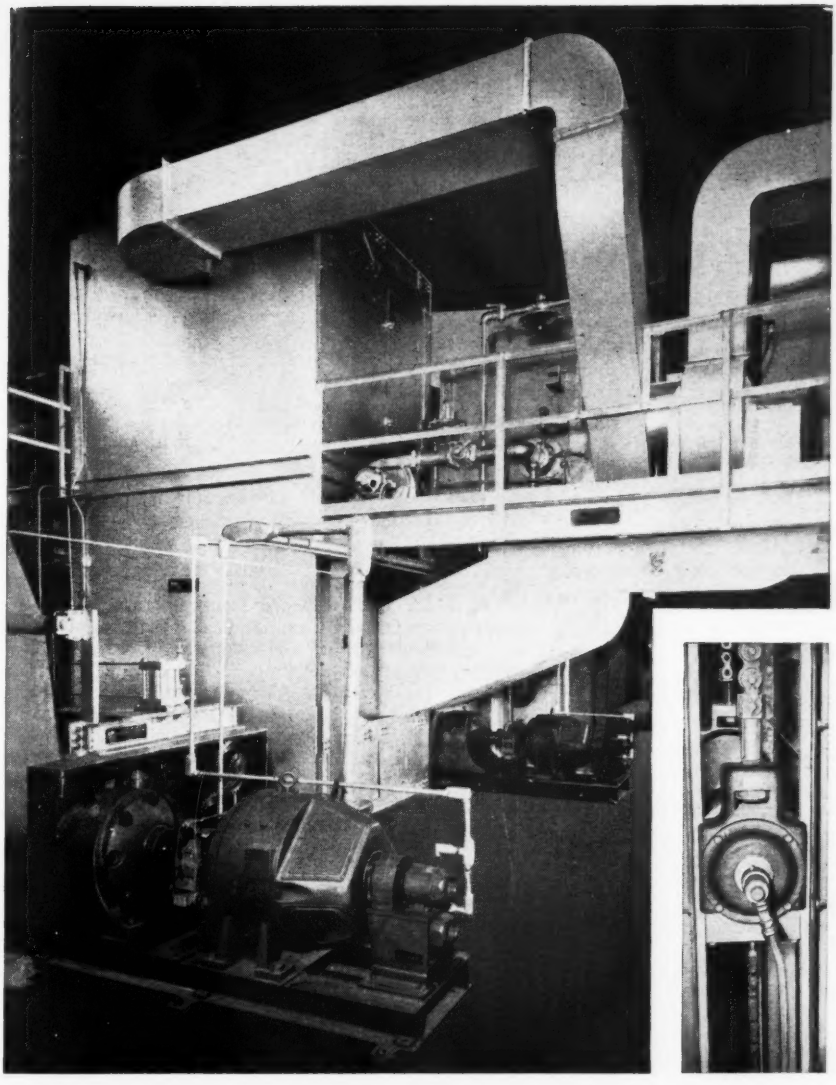
A new line of 600- to 4,000-psi. cylinder-operated hydraulic control valves, designed for use where high-speed response, maximum compactness, and employment of higher valve operating pressures are desirable, has been announced by Sinclair-Collins Valve Co.

Use of an integral double-acting cylinder for valve operation is said to reduce valve mounting space requirements to a minimum and to afford split-second response due to positive pressure actuation in both directions. Valve operating pressure range is 60 to 140 psi., using air, water, or oil.

Available in two- or three-way types, adaptable for either NO or NC operation, depending on pipe connections, the new valves are especially suitable for leakfree control of water, glycol, or oil-base hydraulic fluids, says the manufacturer. Port sizes of one-, 1½-, and two-inch NPT are offered, and valves are fitted for remote pilot control.

Constructed of corrosion-resistant materials, Sinclair-Collins' new cylinder-operated valves feature Navy "M" bronze bodies, hardened stainless-steel valve stems and replaceable seat sleeves, plus Stellite seats for minimum wear and longest service life. Complete parts interchangeability, attributed to precision manufacturing techniques, is claimed to simplify in-service maintenance.

For further information and descriptive literature, write Sinclair-Collins Valve Co., 454 Morgan Ave., Akron, O.



Within the first day of startup, full width nylon tire cord processed in this 30-yard-per-minute, 14,000-pound-tension **IOI** Rollevator® Oven*, was made into aircraft tires meeting all qualification tests.

The Rollevator® roll automatically moves up and down within the oven, in direct relation to line speeds. Thus, at *any line speed, heat-exposure* time of the nylon is held *constant* at a constant temperature setting and at constant tension.

Rollevator® Oven* hot stretches nylon tire cord at constant optimum temperature, constant time and constant tension, at variable line speeds

The IOI Rollevator® Oven* is the answer to more uniform hot stretching of nylon with greater production efficiency. Simple and automatic in operation, it practically eliminates costly shutdown and repair time. When the line is stopped the Rollevator® roll automatically lowers out of the heat zone, eliminating the need for quick cool purging of the oven and the time and expense involved in reheating the oven when starting up again. Its low operating cost combined with low initial cost assures you of lower production cost. An IOI sales engineer will be glad to give you complete information about the Rollevator® Oven* and to discuss your requirements for any system from 3 to 100 yards per minute.

®Trade Mark Registered
*Pat. Applied For

INDUSTRIAL OVENS, INC.
13813 TRISKETT ROAD — **CLEVELAND 11, OHIO**

IOI ENGINEERING VERSATILITY

NEW MATERIALS

Poly-Sperse R-100

Poly-Sperse R-100, a new low-cost activating plasticizer for rubber, has been announced by National Polychemicals, Inc., Wilmington, Mass. This material has been specifically designed to maintain a high degree of hardness and stiffness in the vulcanizate while imparting excellent processing characteristics to the green stock. Poly-Sperse R-100 facilitates the dispersion of reinforcing pigments and improves the mold flow of uncured compounds. In addition, vulcanizates containing Poly-Sperse R-100 display better stress-strain, flex resistance, and tear properties.

Poly-Sperse R-100 has slight activating effect on cure accelerators; therefore savings can be realized through both a reduction of accelerator content and faster curing cycles. In stocks reinforced with high styrene copolymers, Poly-Sperse R-100 can decrease the volume cost by partially replacing the reinforcing resin with no sacrifice in hardness, stiffness, or flex resistance.

These properties combined with low cost should make Poly-Sperse R-100 particularly interesting to manufacturers of soling, tile, and automotive and industrial mechanical goods.

Some typical properties of Poly-Sperse R-100 include:

Appearance	brown liquid
Brookfield viscosity, typical values @	
20° C.	5400 cps.
25° C.	4600 cps.
39° C.	1600 cps.
48° C.	1200 cps.
Specific gravity @ 24° C.	0.99
Storage stability	excellent.
Standard package	450 lbs. net (steel drum)
	40 lbs. net (steel pail)

Depending on the amount of reinforcing pigments in the formula, from two to ten parts of Poly-Sperse R-100 are used per 100 phr.

O₃ Resistant Hycar 1072

Development of an ozone-resistant compound utilizing Hycar 1072, an ozone resistant polymer,[1] has been carried out by the B. F. Goodrich Chemical Co., Cleveland, O., in a project designed to test this polymer with antiozonants added for further improvement of ozone resistance. The project compared the results obtained on Hycar 1072 compounds with and without antiozonant with a typical neoprene compound.

It was concluded from the results that at least an eightfold improvement in ozone resistance was realized by adding antiozonants to a Hycar 1072 compound with low loading. Results obtained on the unprotected polymer very nearly duplicated those reported in the previous work. Aging specimens in oil before exposure greatly improved the ozone resistance of the unprotected material. The neoprene compound used in the test for comparison developed one crack in 71 hours; and after aging in oil, this same compound broke between 23 and 47 hours. It appeared that the time of exposure to a specified degree of deterioration could be greatly increased by aging the sampls in oil before exposure.

Recipe data, original properties, and test results are available in report form from the company; this report is designated Project 2732-81.

[1] RUBBER WORLD, Sept., 1956, p. 916.

Paracril Ozo—Nitrile-Vinyl Blend

Paracril Ozo, a new addition to the Paracril family of oil-resistant nitrile rubbers, is made by modifying a standard Paracril with Marvinol (Naugatuck's vinyl resin). The resulting product, after vulcanization, retains the excellent rubber qualities of Paracril—high physicals, high abrasion resistance, etc.—and, in addition, has many outstanding values such as ozone resistance and very high oil resistance.

Paracril Ozo is supplied in the form of small flakes for maximum ease of handling. It has a specific gravity of 1.09 and contains both rubber and vinyl stabilizers. Its properties suggest its use in wire jackets, oil-resistant shoe soles, molded and extruded mechanical goods such as hose and conveyor belt covers, coated fabrics, and many other applications.

A technical bulletin, No. 219, describing the material, its processing, basic compounding, and typical formulations is available from Naugatuck Chemical Division of United States Rubber Co., Naugatuck, Conn.

Silastic Adhesive S-2200

Silastic Adhesive S-2200, a general-purpose adhesive produced by Dow Corning Corp., Midland, Mich., is claimed to give more consistent adhesion and stronger bond strength than any other high-temperature adhesive for Silastic-to-metal and Silastic-to-Silastic applications. This new adhesive is easy to spread, and tests to date indicate that it does not thicken or setup even after two or three months of shelf life.

No primer is needed if the bonded part is cured four or more hours at 480° F. If lower cure is used, the part should be primed with A-4094 Primer, which prepares the surface through hydrolysis.

Some typical properties of Silastic Adhesive S-2200 are listed below:

Color	translucent
Specific gravity	1.10
Brittle point, ° F., ASTM D 746–55T	−100
As vulcanized, is serviceable	−70 to 500° F.

Some typical properties of Dow Corning A-4094 Primer are as follows:

Color	light straw
Viscosity at 25° C., cstkes	less than 1
Flash point, ° F	50
Solvent	VM&P naphtha
Applied	brush, spray

Preliminary data sheets for Silastic Adhesive S-2200 and Dow Corning A-4049 primer are available from the company.

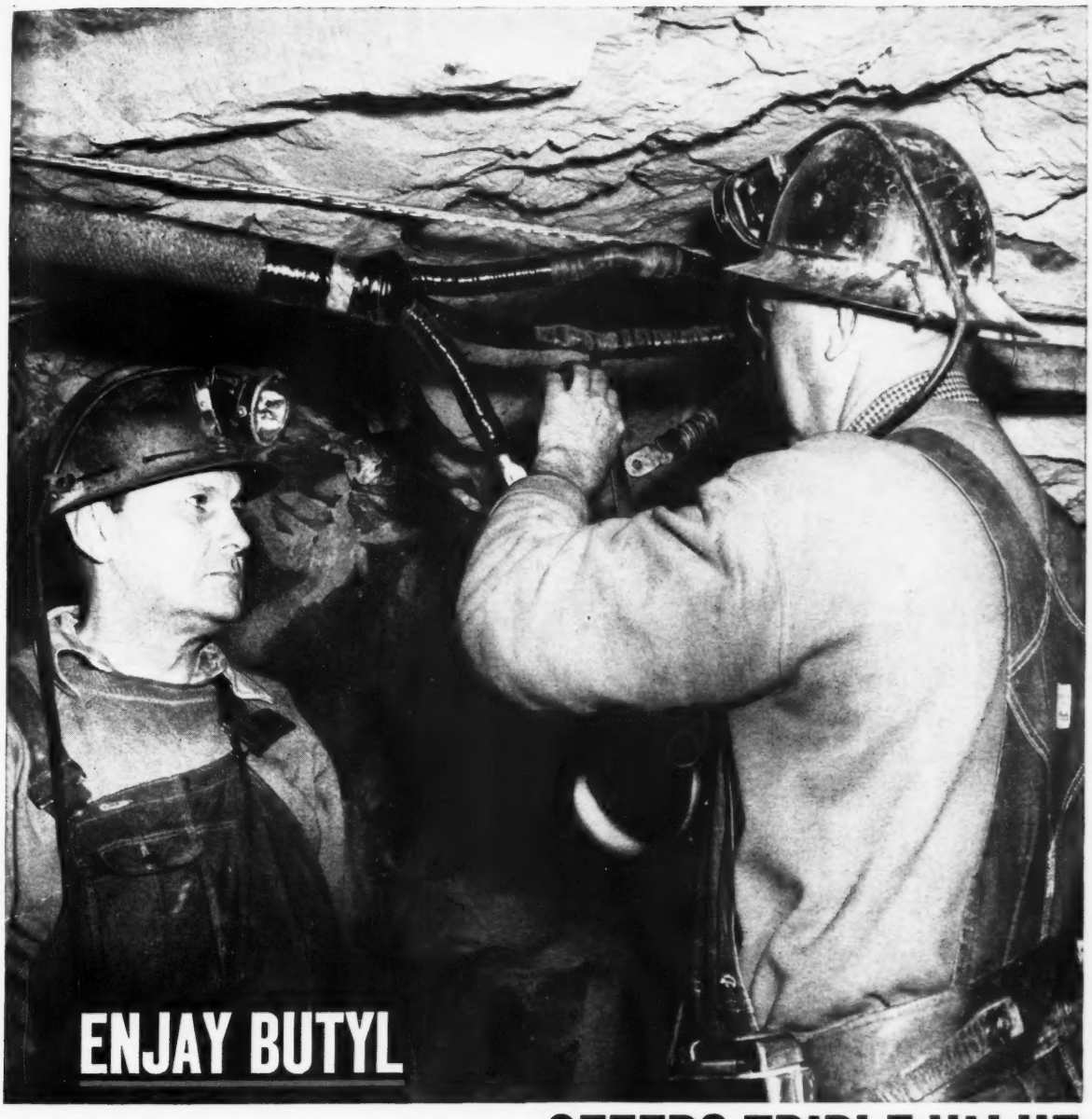
Brominated Flameproofers

Michigan Chemical Corp., St. Louis, Mich., has announced a series of new brominated compounds used to impart flameproofing and self-extinguishing characteristics to plastics, protective coatings, fluids, textiles, paper and wood products where fire resistance is important. The new products are tetrabromobisphenol-A, tetrabromophthalic anhydride, tris(2-bromoethyl) phosphate, pentabromophenol, and tris(2,3-dibromopropyl) phosphate.

These products possess the fundamental flameproofing superiority of brominated compounds which are several times more efficient than their chlorine analogs. This basic advantage permits the use of smaller quantities of the additive than would be required with chlorine compounds. As a result, there will be less disturbance of the physical properties and appearance of the end-product and less adverse effect on product utility, it is claimed.

The possibility of brominating curing agents, monomers, and basic resins themselves to achieve a built-in flameproofness is a related phase of research and development being carried on by the company.

Testing quantities of the new flameproofing compounds are available from the company.



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Underground service cables, transformer housings, high-voltage industrial cables . . . in these, and many other electrical applications, Enjay Butyl outperforms and out-lasts *all other* types of rubber, synthetic *or* natural. *Low-in-cost* and *immediately available*, this truly wonder rubber may well be able to cut costs and improve performance in *your* products. For further information, and for expert technical assistance, contact the Enjay Company.

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NEW PRODUCTS

Goodyear 11:00-14, *left*, and 7:50-14, *right*, 1958 tires

New Low-Pressure Tire

The Goodyear Tire & Rubber Co., Akron, O., has indicated that it will continue the trend toward bigger tires with lower pressure on 1958 cars. The company's tires on 1958 cars will range in size from 7.50-14 to the super-soft 11.00-14 luxury tire recently announced by the Chrysler Corp. for use in limited quantities on the Imperial model. This range compares with a range two years ago from 6.70-15 to 8.20-15.

The new tires have been developed expressly to provide increased riding comfort and improved styling. Goodyear's 11.00-14 tire is constructed of rayon with the company's custom-tread pattern. Recommended air pressure for the new tire will range from 14 to 17 psi. The extra-low pressure and wide design enable the tire to envelop and absorb smoothly and quietly the shock of small objects and road irregularities. The wide tread improves braking and car control.

All-Nylon-Cord Bicycle Tire

The first bicycle tire of all-nylon-cord construction also is being marketed by Goodyear. Called the Suburbanite "175" Nylon, the tire features a stronger, more resilient carcass than conventional bicycle tires. Its open-lug design, self-cleaning cleats, and bladed riding ribs give the tire firm traction in snow, sand, and mud and on icy or wet surfaces.

With the use of nylon cord, the firm has augmented the year-round serviceability of the Suburbanite line, which was introduced last year. Bike users are said to gain further protection against bruising and cutting, more flexibility in their tires, and resultant longer wear.

The new tire is available in size 26 x 1.75, blackwall. It is being produced in quantity and also is being warehoused nationwide.

New Rubber Heel by BFG

BFG's Extrawear heel

Production of a new rubber heel for men's shoes, designed for use by both shoe manufacturers and the repair trade, was begun in Clarksville, Tenn., at the shoe products plant of B. F. Goodrich Industrial Products Co. The new heel, called Extrawear, is of modern design and made with either contrasting or matching inserts.

The new product is said to be a companion item to the company's "Extrasoft" heel, a popular seller noted for its extraordinary softness. The Extrawear is being offered as a complete line in non-marking black and brown colors. It will go on sale to shoe manufacturers and the repair trade throughout the nation and will sell in the medium-price range.

New Heavy-Duty V-Belt

A new V-belt construction, developed especially for use on oil-rig pump and other long center industrial drives, has been announced by Manhattan Rubber Division of Raybestos-Manhattan, Inc., Passaic, N. J. The new Condor LS belt (length stabilized) features a precision proportioned construction reported to eliminate V-belt whip and similar causes of belt turnover and eventual failure. Completely redesigned belt compression area and repositioned strength members give the new belt a degree of lateral and longitudinal stability never before possible with long center rig drives.

New high tensile, super-strength synthetic fabrics have been used in the construction of the belt which is preformed before vulcanization to preserve the specially precisioned balance of the newly engineered component parts of the belt's internal structure.

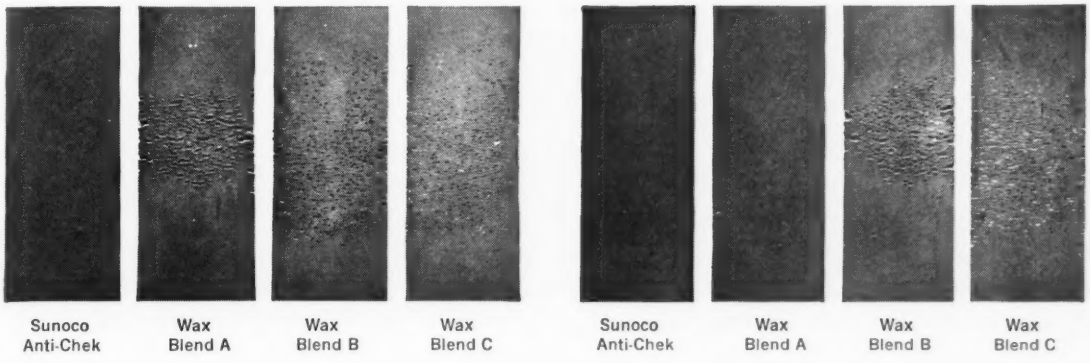
As a further assurance of positive V-belt length control, the new Condor LS belts are scientifically destretched during manufacture, factory measured under controlled humidity, and length certified. Finally, they are packed under vacuum in special heat-sealed, aluminum-lined, moisture-proof bags. The exclusive vacuum package stabilizes belt length and keeps it factory fresh. With V-belt length controlled from factory to installation, V-belt matching problems are practically eliminated.

The new Condor LS belts are available through the company's distributors and recognized oil-field supply stores. A copy of an illustrated folder is also available from the company.

"Trapped Air" Life Preserver

A new lightweight life preserver for use by combat troops has been developed jointly by Rubber Fabricators, Inc., Grantsville,

Left, kapok preserver; *right*, new "trapped air" preserver



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You get better resistance to aging with less Sunoco Anti-Chek Wax

The controlled blooming rate of Sunoco Anti-Chek® gives *predictable* long-life weather-protection to your finished rubber products. Unlike ordinary waxes, that bloom too fast to last, Anti-Chek blooms at the optimum rate for longest service life. Result: You need *less* Sunoco Anti-Chek to get *better* resistance to sunlight, ultraviolet light, and ozone than ordinary waxes can provide.

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New Products

W. Va., and the U.S. Army Transportation Research & Engineering Command, Fort Eustis, Va. Designed to replace the excessively bulky and cumbersome World War II kapok and the belt types inflated by CO_2 capsules, yet incorporating desirable elements of both, the new preserver will utilize the "trapped air" principle.

The design was derived from the addition of an air expandable collar assembly to a lightweight, fixed pad preserver. When the wearer falls into the water, a hydrostatic pressure forces the trapped air to the upper torso, thus providing support and buoyance. The body and the head of the wearer are supported even if he has lost consciousness since the new preserver does not rely upon oral, mechanical, or chemical means of inflation. When not in use, the preserver can be rolled up into a pocket-size package weighing less than three pounds. A valve is provided to release the trapped air from the preserver for storage and shipment.

The preserver is said to be non-corrosive in salt water and will not propagate a flame if ignited. Weight and bulk of the fixed pads have been cut down by use of stays to assure retention of the required air volume within the pads. Compartmentation and use of light waterproof fabrics to encase the air cells offer insurance against puncture.

The new design was developed to meet an Army requirement for a new and improved life preserver which would provide buoyancy and permit unrestricted body movement with minimum discomfort.

Silicone Rubber

(*Continued from page 716*)

Summary

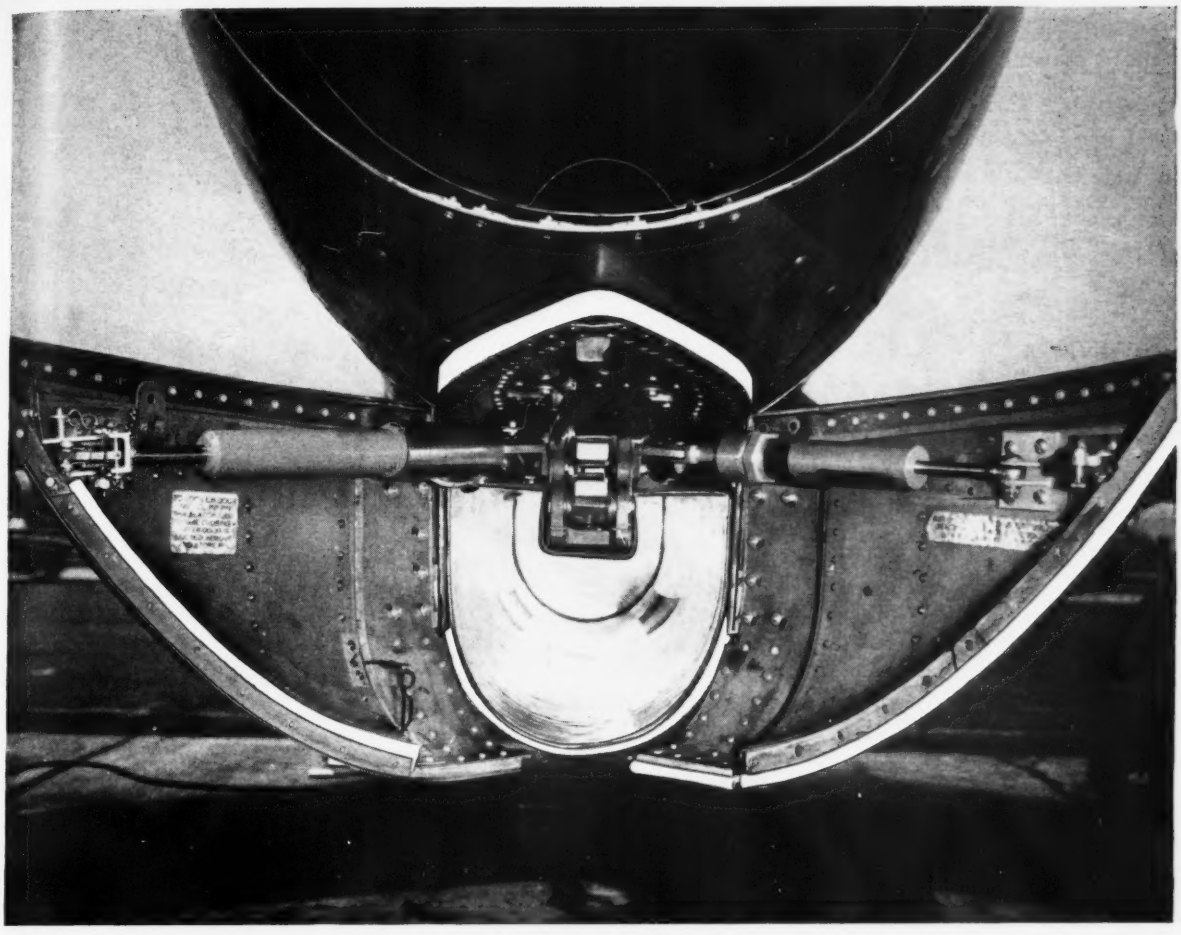
On the basis of the results obtained in this investigation, it is apparent that no one vulcanizing agent investigated to date can successfully vulcanize silicone rubber to suit all purposes.

Benzoyl peroxide, dichlorobenzoyl peroxide, and tertiary butyl perbenzoate all function well with both dimethyl and methyl vinyl polymers. Physical properties produced with these three peroxides are good when the right amounts are used. Dichlorobenzoyl peroxide exhibits the best overall characteristics as it vulcanizes all types of polymers, gives from fair to excellent results in each of the applications tested, and vulcanizes in the least time at the lowest temperature. Care must be taken with dichlorobenzoyl peroxide, however, to avoid scorching.

Ditertiary butyl peroxide exhibits excellent vulcanizing characteristics when used with methyl vinyl polymers. It is essentially outstanding with regard to curing of thick sections, curing carbon black filled stocks, and when minimum compression set is desired. DTBP is, however, very volatile and evaporates quite rapidly from the compounded stocks.

Dicumyl peroxide appears limited to the vulcanization of methyl vinyl polymers when curing thick sections and/or curing carbon black filled stocks are the prime considerations.

The optimum amount of peroxide to use for a desired application is fairly critical except when dicumyl peroxide or ditertiary butyl peroxide is used. This optimum amount depends almost entirely on the particular application as well as on the vulcanizing agent involved.



SILASTIC 440 Gum

For Seals that Stay Resilient to –130 F

TYPICAL PROPERTIES OF
LOW TEMPERATURE SEALS
MADE WITH SILASTIC 440 GUM

Temperature range, °F	−130 to +500
Tensile strength, psi	900
Elongation, %	325
Tear strength, ppi	90
Compression set, %	30
Hardness, Durometer	50
Extrusion	Good

All properties obtained on ASTM slabs molded 5 minutes at 240 F. and cured 4 hours at 300 F.

A team of compounding and fabricating experts is available for visits to your plant. If you would like this team to work with your group, contact your Dow Corning representative.

Compounding of stocks for seals that stay rubbery despite prolonged exposure to bitter cold is easier with Silastic* 440 Gum. This Dow Corning silicone rubber gum is ideal for many low-temperature applications. It has inherent low compression set; provides excellent resistance to weathering, ozone and moisture. Stocks made from Silastic 440 Gum can be extruded, calendered or molded.

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TECHNICAL BOOKS

BOOK REVIEWS

"Bibliography of Rubber Literature for 1949-51." Editor-in-chief, M. E. Lerner. Published by Division of Rubber Chemistry, American Chemical Society, 318 Water St., Akron 8, O. Cloth cover, 6 by 9 inches. 600 pages. Price $7.50.

This ninth edition of the "Bibliography of Rubber Literature" covers literature and patents on rubber that appeared in the years 1949, 1950, and 1951. This book contains 6,412 references, as compared to the previous edition which also covered a three-year period and had 5,950 references. The increases in references are reflected in most of the classifications, but are particularly heavy in the sections devoted to synthetic rubbers and rubber-like materials.

A letter-number identification system similar to that of previous editions is used. The journal abbreviations used for the most part follow those established by the American Chemical Society.

As stated by Mr. Lerner in the preface, the Division of Rubber Chemistry is anxious to bring these bibliographies up to an annual basis as soon as possible. Unfortunately, owing to a number of circumstances, publication of the current edition has been considerably delayed, with the result that the time table established by the bibliography committee some three years ago has been upset. Considerable work has already been done on the next edition covering the period 1952-54, and it is hoped that this edition can be published early in 1958. John McGavack, of United States Rubber Co., is chairman of the bibliography committee.

"Epoxy Resins. Their Applications and Technology." By Henry Lee and Kris Neville. Cloth cover, 6 5/16 x 9 5/16 inches, 314 pages. McGraw-Hill Book Co., Inc., New York, N. Y. Price, $8.

This book gives an authoritative and comprehensive discussion of the synthesis, curing mechanisms, and curing agents of epoxy resins as well as a detailed guide to their use in industry.

The synthesis and characterization of epoxy resins are covered in Chapter 1. The simplest form of the epoxy molecule is represented by the diglycidyl ether of bisphenol A. The most widely used liquid epoxy resins are predominately of this structure. Detailed instructions are given for preparing a typical epoxy resin from bisphenol A and epichlorohydrin in a basic solution. The synthesis of low molecular weight resins involves the use of an excess of epichlorohydrin and carefully regulated amounts of caustic; the higher molecular weight species are made using an excess of caustic and carefully controlled amounts of epichlorohydrin. A list of commercially available epoxy resins with their physical and chemical properties is included in this chapter.

Chapters 2 to 5 inclusive discuss in considerable detail the mechanisms of curing epoxy resins and the curing agents available. Chapter 2 explores the general chemistry of curing processes, calculation of amount of curing agent, determination of degree of cure, and characterization of the cured resin. Chapters 3 and 4 describe amine, amine-adduct, amide, and latent curing systems. A chemically interesting latent curing agent described is the boron trifluoride — monoethanolamine complex. Chapter 5 treats of the use of organic acids and acid anhydrides as curing agents. It was noted here that pyromellitic dianhydride and chlorendic anhydride produce cured resins having high heat distortion and high temperature stability.

Chapter 6 is a study of the changes in the properties of cured epoxy resins that are brought about by incorporating into the uncured liquid various diluents, fillers, and other synthetic resins.

QUESTION
WHAT
will keep this
uncured rubber from
STICKING
when slabbed
or stacked
in storage
ANSWER
A microscopic film of
GLYCERIZED
(LIQUID CONCENTRATE)
LUBRICANT
You won't be able to see it on the rubber but you will know of its presence because of the non-adhesive properties it imparts. Does not interfere with tack or knit of stock.
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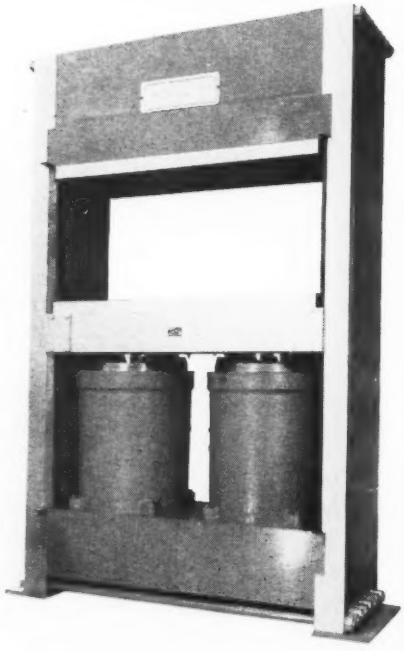

904 ton
Side Plate
Molding Press
28" Stroke
1-32" Opening
74" x 32"
Pressing Surface

Shown above is one of the many different types of French hot plate molding presses specially designed for the rubber industry.

Available in all sizes to meet specific molding requirements, French presses are engineered to exact specifications and assure greater production efficiency with minimum scrap.

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Technical Books

Some methods whereby the cured resin may be made flexible and more impact-resistant are described in Chapter 7. The chief method of enhancing these properties is by using, what the authors term, flexibilizers. These are mono- or polyfunctional materials that chemically react with the resin and impart flexibility by becoming an integral part of the cured system. Among the most important flexibilizers are epoxidized vegetable oils, polyamide resins, polysulfides, fatty diamines, and certain polyesters.

Industrial applications are discussed in Chapters 8 to 11 and include such topics as casting, potting, sealing, lightweight foams, adhesives, laminates, and coatings. Typical formulations, fabrication techniques, cure cycles, and product characteristics are discussed in detail in these sections.

The book closes with Chapter 12 on the methods of handling epoxy resins and curing agents, incorporation of fillers, metering ingredients, selection of mixing equipment and good safety practices.

This is a well-written book and contains a wagon-load of information about epoxy resins useful to chemists, chemical engineers, aircraft and missile engineers, electronic and electrical power engineers, and corrosion engineers.

NEW PUBLICATIONS

"Kenmix Dispersions." Kenrich Corp., Maspeth, N. Y. 11 pages. This technical data sheet covers the firm's premixed accelerator dispersions for butyl, neoprene, and Hypalon compounds. The dispersions are based on the use of Kenflex A, Kenflex N, and Kenflex N MB, highly aromatic hydrocarbons with unusual wetting properties and unique dispersing abilities. Basic recipes, formulations, typical physical properties, and price lists are included.

"Fan Belt and Radiator Hose Application Data Book." Gutta Percha & Rubber, Ltd., Toronto, Ont., Canada. 64 pages. This illustrated booklet lists the individual applications of passenger, truck, and tractor fan belts, together with construction features, dimensions, interchangeability guide, installation charts, and descriptions and specifications of the company's whole line of fanbelts, V-belts, and wedge belts. The applications by vehicle, construction features, descriptions of curved shapes and dimensions, cutters, racks, specifications, and clamps of the entire range of radiator hose are covered in the second and third sections.

"Green Book, 1957-58 Buyers Directory." Schnell Publishing Co., Inc., New York, N. Y. 1784 pages. This directory, published as part of annual subscription to the weekly newspaper, *Oil, Paint & Drug Reporter,* is divided into three parts: (1) chemicals and related materials, (2) services (technical and commercial), and (3) alphabetical directory of addresses. The book gives complete information concerning sources of supply for chemicals and related materials.

"Mark Stabilizers." Argus Chemical Corp., Brooklyn, N. Y. 24 pages. This technical bulletin, on the stabilization of polyvinyl chloride, deals with barium-cadmium stabilizer systems and the applicability of various Argus Mark stabilizers for specific functions. The bulletin also contains detailed technical data on each item.

"Enjay Butyl Latex—MD-600-55—for Cord Treatment." Enjay Co., Inc., New York, N. Y. 2 pages. This technical bulletin describes the company's MD-600-55 experimental butyl latex, said to have better mechanical, freeze and storage stability than ENJ-B-12 latex.[1] Various formulations and results are given.

[1] See our Dec., 1957, issue, p. 398.

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COLD	PHILPRENE 1500 PHILPRENE 1502 PHILPRENE 1503	PHILPRENE 1600 PHILPRENE 1601 PHILPRENE 1605
COLD OIL	PHILPRENE 1703 PHILPRENE 1706 PHILPRENE 1708 PHILPRENE 1712	PHILPRENE 1803

Philprene rubbers are designed to meet your individual requirements and special needs. In the manufacture of calendered, extruded or molded goods there's a Philprene polymer that will give you excellent physical properties plus easy processing. For waterproofing . . . insulation . . . extra wear resistance or other special qualities, consult your Philprene brochure for the polymer that is best suited for your particular product.

Your Phillips technical representative can help with specific rubber problems. Years of rubber experience plus the facilities of Phillips modern technical laboratory are at your service!

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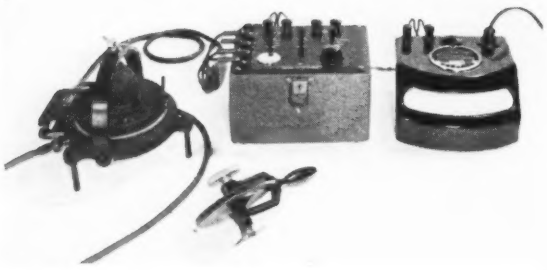

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The rate of permeation through the fabric is quickly determined by equipment utilizing the thermal conductivity method and is indicated in terms of liters per square meter per 24 hours of the retained gas.

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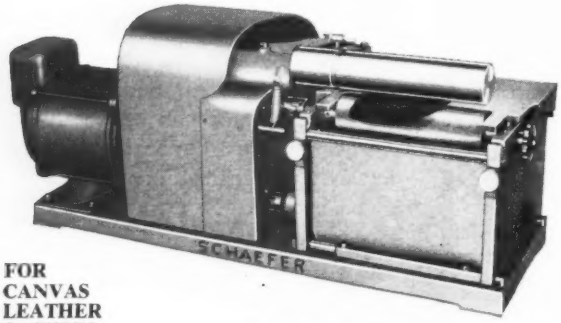

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ASBESTOS
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CARDBOARD
HARD RUBBER
FOAM RUBBER
PLASTIC FOAM
SPONGE RUBBER
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Technical Books

Publications of the Barrett Division, Allied Chemical & Dye Corp., New York, N. Y.:

"'A-C' Polyethylene Lubricant 8408 in Black-Filled Butyl Rubber Compound." Rubber Laboratory Release No. 21. 8 pages. As the title indicates, this booklet presents an evaluation of the company's "A-C" Polyethylene Lubricant 8407 in a black-filled butyl rubber compound. It describes the ASTM test procedures, typical properties of Lubricant 8407, and basic formulae and gives a summary of physical test data.

"'A-C' Polyethylene Lubricant 8417 in an Oil-Extended SBR Soling Compound." Rubber Laboratory Release No. 22. 8 pages. This report offers an evaluation of Polyethylene Lubricant 8417 in an oil-extended SBR soling compound. It includes ASTM test procedures, typical properties of "A-C" Polyethylene Lubricant 8417, basic formulae, a summary of physical test data, and tension and hardness data under aged and unaged conditions.

"Evaluation of Non-Black Fillers for Colored Butyl Compounding." Thiokol Chemical Corp., Trenton, N. J. 16 pages. This booklet with tables and appendix gives an evaluation of the extrusion properties of individual fillers, including very fine particle-size fillers, calcium carbonates, clays, and miscellaneous fillers as well as data on the practical compounding of blends of these various types of fillers to obtain optimum extrudability and processability.

"Evaluation of Non-Black Fillers for Colored Butyl Compounding." Group II—Calcium Carbonates. Bulletin 104-2. 8 pages. This bulletin presents the study, the results, the physical properties, and extrusion data for 12 commercial types of calcium carbonates when compounded as fillers, or blends of fillers, to provide smooth, colored butyl extrusion compounds and to develop effective butyl compounds for use with these fillers.

Publications of Dow Corning Corp., Midland, Mich.:

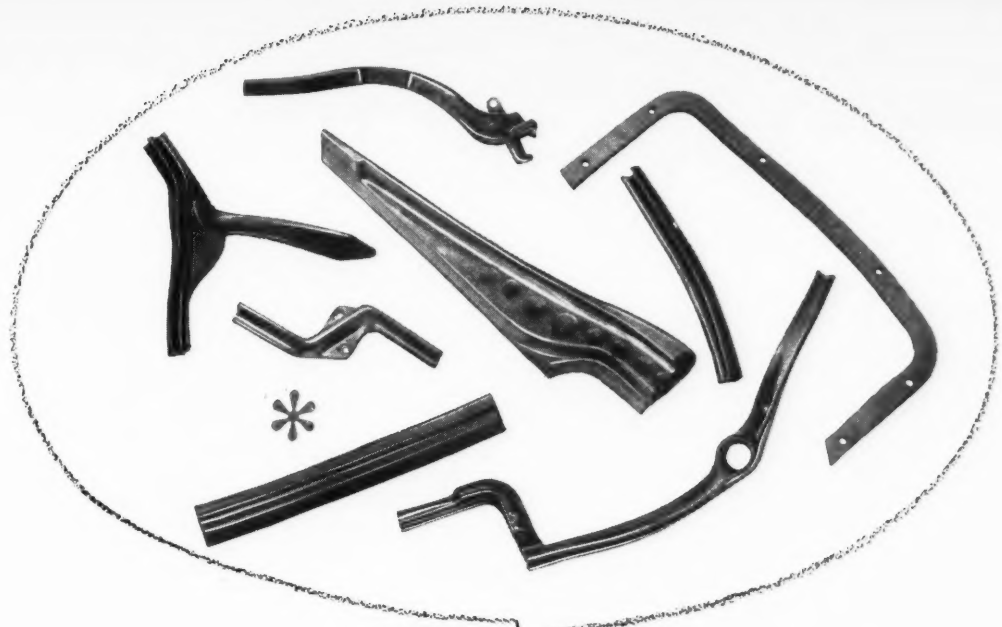
"Silastic 916." 9-381. 1 page. This data sheet gives the specifications, typical properties, and typical properties with various cures of Silastic 916, said to be the first silicone rubber that combines high strength with the thermal stability characteristic of silicone rubbers.

"Silastic Fabricators." 9-905. 4 pages. This data sheet lists rubber companies which fabricate parts with Silastic silicone rubber. The types of parts made by the companies are included.

"Dow Corning Silicones—1958 Guide." 16 pages. The silicone products of greatest general interest are briefly described in this guide. Reference numbers are used to help the reader obtain the most recent and comprehensive data on any of the various silicone products described. Additional information on other silicone products for more specialized applications may be obtained from the company.

"B. F. Goodrich Flooring Products." B. F. Goodrich Flooring Co., Watertown, Mass. 16 pages. This four-color 1958 general catalog includes complete information on the company's rubber tile, Airpath cushioned rubber floor tile, Agatine tile, Koroseal vinyl tile; also a new introduction, fire-retardant Koroseal vinyl tile; asphalt tile; molded rubber cove base; molded rubber stair treads; edging strip; thresholds; chair rail; and Rubaduct. This catalog also includes flooring product definitions, specifications, features, latest colors, and other pertinent information.

"Mark 1-F4 Electron Linear Accelerator." Applied Radiation Corp., Walnut Creek, Calif. 8 pages. This brochure describes the company's Mark 1-F4, a traveling wave linear electron accelerator, designed for research in radiation chemistry and for limited commercial radiation processing. The machine, for sale or lease to plastics fabricators, manufacturers, and laboratories, is a high-powered descendent of the atom smashers developed at Stanford. It emits high-energy electrons, X-rays, or neutrons as desired. Its electron beam, variable in energy from 2 to 10 million electron volts, can penetrate material of unit density up to 1¼ inches thick from one side. At full power (four kilowatts), it can process a maximum of 3,000 megarad-pounds per hour; yet it is only 12 feet high and weighs less than 6,000 pounds.



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Technical Books

Harwick Standard Chemical Co., Akron, O., has issued a corrected sheet, #06-42-4-12-57, HSC #39 Oil, which makes the following corrections on #06-42-11-57: flash point (Cleveland open cup), 320° F.; fire point (Cleveland open cup), 340° F.

"Peracetic Acid and Derivatives." Union Carbide Chemicals Co., New York, N. Y. 48 pages. This booklet includes a treatise on peracetic acid, reactions of epoxides, and an extensive bibliography supporting these sections. This brochure also lists properties and possible uses of 12 epoxides now available in research samples.

"Symposium on Radiation Effects on Materials." Technical Publication 208. American Society for Testing Materials, Philadelphia, Pa. $4.75. 196 pages. This symposium is the first of a series sponsored jointly by ASTM Committee E-10 on Radioisotopes and Radiation Effects and the Atomic Industrial Forum. It was presented at the ASTM second Pacific area national meeting, Los Angeles, September, 1956. The symposium is divided into three parts: theory of radiation; radiation facilities and mechanics of testing; experimental tests and results on (a) fuel and graphite materials, (b) structural materials, including organics. Following the introduction the three parts contain a total of 16 papers, most of them accompanied by discussion. The book contains numerous tables of data and is well illustrated with photographs, diagrams, and graphs.

"Accu-Cast." Manco Products, Inc., Melvindale, Mich. 4 pages. The advantages that this new Accu-Cast process brings to molders, die casters, foundries, pattern makers, forges, and extruders are outlined in this illustrated folder. It describes the Accu-Cast method of precision-casting mold and die components in steel and other castable metals, direct from expendable original patterns, with no need of costly and time-consuming machining of steel master hobs.

"Big Plus in Processing Equipment and Systems." Sprout, Waldron & Co., Inc., Muncy, Pa. 20 pages. This new bulletin has just been released for use in the chemical, processing, and pulp and paper industries. The booklet is a general introduction to the complete line of processing equipment manufactured by the company. Bulletin 178, utilizes the "Big Plus" theme and shows how Sprout-Waldron equipment offers a combination of factors which provide the utmost in economy and efficiency in processing equipment.

"Use of Fire-Resistant Hydraulic Fluids in the Plastics Industry." The Society of the Plastics Industry, Inc., New York, N. Y. 2 pages. This bulletin, designed to help reduce fire hazards in the plastics industry, suggests the use of three types of fire-resistant hydraulic fluids in place of petroleum-based hydraulic fluids. These types are (1) water-base synthetic fluids (water-glycol mixtures), (2) straight-synthetic or non-aqueous types (a. phosphate ester-types, b. chlorinated hydrocarbons, c. fluorinated hydrocarbons), and (3) water-soluble emulsions. Some typical physical characteristics are included.

"Atomic Energy Facts." U. S. Atomic Energy Commission, Washington, D. C. 216 pages. This volume, illustrated with 86 drawings, photographs, and flow charts, is a handbook on nuclear operations in the United States for industrial management and others active or interested in atomic energy. The book, entirely devoted to peaceful uses of atomic energy, combines and organizes material from many Commission sources as well as describes the organization and functions of the Commission. Among other topics discussed include programs for training and education in nuclear science and technology, activities of major AEC contractors, raw and feed materials, reactor development, and radioisotope development. The book, paper bound, may be purchased for $2.00 from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.

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Technical Books

"Non-Black Butyl Extrusion Compounds." J. M. Huber Corp., New York, N. Y. 4 pages. This technical data sheet lists the physical properties, the uses, and the processing characteristics of various non-black pigment reinforced butyl compounds. Enjay Butyl 365 was compounded with various ratios of different pigments, and the subsequent extrusion characteristics were studied.

"A Study for Management—The Univac II Data Automation System." Rand Univac Division of Sperry Rand Corp., New York, N. Y. 196 pages. This illustrated manual is an aid to help top management investigate the electronic computer, its capabilities, operation, and applications. The introductory section presents a study of the data processing areas in a typical manufacturing firm, then a listing of current computer applications, classified by type of industry. A survey of the types of data processing systems also appears. Selection and organization of a computer are given next, followed by the operations of the Univac system itself. A complete introductory course of Univac programming, suitable for use as a classroom text, is presented in five sections. Test exercises and answers are provided as well as techniques for sorting data and common operational routines.

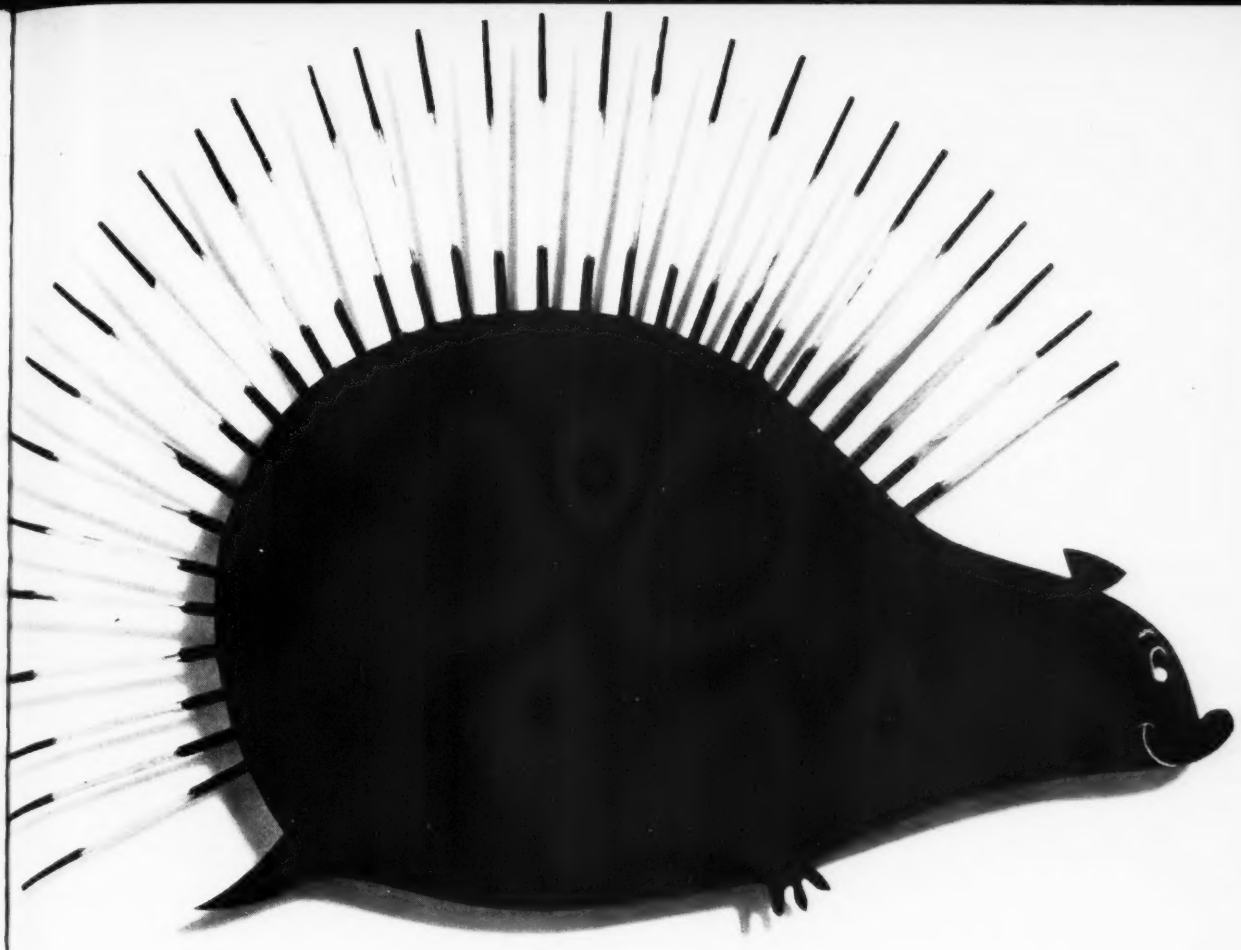
"Powdered Activated Nuchar for Purification and Reclamation." Industrial chemical sales division, West Virginia Pulp & Paper Co., New York, N. Y. 12 pages. This booklet offers hints on the use of Nuchar for the removal of impurities and objectionable taste and odors and on Nuchar's ability to adsorb desirable materials which are to be recovered. Nuchar has been found to have many uses in a wide range of industries and products, including water works treatment, reclaimed rubber, alcoholic beverages, food, dry cleaning, electro-plating, insecticides, plastics, fine chemicals, and pharmaceuticals.

"Who Makes Machinery?—Buyer's Machinery Guide—1957." Nordeman Publishing Co., Inc., New York, N. Y. 800 pages. Published by Verlag Hoppenstedt, Darmstadt, Germany, on behalf of the Association of German Machinery Manufacturers. This English-language directory features complete listings of 20,000 manufacturers of all types of machinery, precision instruments, and industrial equipment, classified in 9,000 product categories. It is available in English, French, German, Spanish, and Italian at $3.00 from Nordeman Publishing Co. Inc.

"Comparison Chart for Electric Fork Lift Trucks." Lewis-Shepard Products, Inc., Watertown, Mass. This chart enables users to survey simultaneously the operating, design, and maintenance characteristics of three different trucks by filling in appropriate categories. Included are such items as turning radius, lifting and lowering speeds, fork elevations, collapsed height, type of controls, capacity and braking system. The chart is available free from the company.

"Norelco Autrometer—Automatic Indexing X-Ray Spectrograph." Philips Electronics, Inc., Mount Vernon, N. Y. 8 pages. This booklet explains the operation of the Autrometer, a nondestructive analytical tool, and describes how it prints out intensity ratios on one to 24 elements in a single sample, with elasped time frequently one-fiftieth that required for chemical analysis. This device can be used for handling elements from #12 through those having the highest atomic numbers.

"Wood's Sure-Flex Flexible Couplings." T. B. Wood's Sons Co., Chambersburg, Pa. 8 pages. This letterhead-size, two-color bulletin tells how to select new Sure-Flex couplings suited to more than 150 different service applications. Five tables shortcut the usual engineering calculations and give the right answer in a matter of seconds, taking into consideration the type of driver, horsepower, and rpm. as well as the specific application. This patented flexible coupling consists of two flanges and a two-piece rubber sleeve, which lock together without clamps or screws.



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MARKET REVIEWS

Natural Rubber

During the December 16-January 15 period the natural rubber markets continued mainly under the influence of the Indonesian situation, fluctuating, at times rather violently, according to the gist of the reports coming from that country. As the prospects of the immediate movement of Indonesian rubber would reflect differently on the various markets' short positions, the intermediate market reactions were somewhat out of step, although, on the whole, they followed the general pattern, that is, that values were in for a further setback, and in consequence many operators were working on short positions.

In December a preholiday quiet prevailed on rubber markets here and abroad, and during this time prices followed a generally steady pattern. Rubber here followed the world markets lower as the post-holiday doldrums pulled contracts 28 to 50 points lower at the New York Commodity Exchange.

Cable offerings of moderate weights were badly absorbed owing to a general lack of buying interest among both dealers and consumers. Factory interest was described as thin, with some consumer buying at lower levels. Much of the present lull was attributed to the dip in automobile production and the diminished demand for new tires.

Toward the close of the period under review rubber futures reacted sharply upward during a brief period of trading when a small buying interest developed in the heretofore thin market. Quiet reigned in the physicals most of this time, until the late rally in futures prompted a similar move in spot trading. Spot prices were variously reported as unchanged to somewhat higher.

Malaya, during this period, announced that its new independent government has embarked on a long-range effort to boost sales of natural rubber in the United States and elsewhere, in preparation for the day when supply will exceed demand.

December sales, on the New York Commodity Exchange, amounted to 20,560 tons, compared with 13,260 tons for November; none on the Rubber-Standard Contract. There were 21 trading days in December; and 21 during the period from December 16 to January 15 inclusive.

REX CONTRACT

	Dec. 20	Dec. 27	Jan. 3	Jan. 10
Jan.	29.70	29.30	28.20	27.05
Mar.	29.75	29.35	28.35	27.32
May	29.65	29.25	28.40	27.50
July	29.47	29.20	28.40	27.55
Sept.	29.45	29.10	28.35	27.60
Nov.	29.40	29.05	28.35	27.60
1959 Jan.	29.35	29.00	28.35	27.60
Total weekly sales, tons	4,210	1,140	2,650	2,450

On the physical market, RSS #1, according to the Rubber Trade Association, averaged 28.76¢ per pound for the December 16-January 15 period. Average December sellers' prices for representative grades were: RRS #3, 27.82¢; #3 Amber Blankets, 26.68¢; and Flat Bark, 22.05¢.

	Dec. 20	Dec. 27	Jan. 3	Jan. 10
RRS #1	29.63	29.38	28.25	27.38
2	28.75	28.75	27.38	26.75
3	28.25	28.00	26.75	26.13
Pale Crepe #1 Thick	31.50	31.38	30.25	29.75
Thin	31.50	31.38	30.25	29.75
#3 Amber Blankets	27.00	27.00	25.88	25.25
Thin Brown Crepe	26.13	26.13	25.00	24.50
Standard Flat Bark	22.13	21.50	21.25	21.00

Latex

Apart from some spasmodic inquiries during the earlier part of the period under review the market has been reported as dormant. Despite lack of activity, however, it has held steady, and, in fact, the differential for latex in drums has shown a slight improvement, which might be taken as a healthy sign.

The Malayan production in November was reported at 10,314 tons, compared with 10,171 in October, and shipments in November were 9,961 tons, against 8,760 tons in October.

The United States consumption of natural latex during November is reported at 6,735 tons, contrasted with 7,250 tons in October. U. S. stocks on November 30 amounted to 12,315 tons, compared with 12,399 tons at the end of October.

Prices for ASTM Centrifuged Concentrated natural latex, in tank-car quantities, f.o.b., rail tank cars, ran about 35.94¢ per pound solids. Synthetic latices were 22.5 to 31.2¢ for SBR; 37 to 55¢ for neoprene; and 46 to 65¢ a pound for nitrile types.

Final October and preliminary November domestic statistics for all latices were reported by the United States Department of Commerce as given below:

(All Figures in Long Tons, Dry Weight)

Type of Latex	Production	Imports	Consumption	Month-End Stocks
Natural				
Oct.	0	—	7,250	12,399
Nov.	0	—	6,735	12,315
SBR				
Oct.	6,876	—	6,556	7,254
Nov.	6,515	—	5,661	7,764
Neoprene				
Oct.	885	0	788	1,142
Nov.	1,021	0	735	1,181
Nitrile				
Oct.	1,133	0	857	1,723
Nov.	994	0	599	1,487

Synthetic Rubber

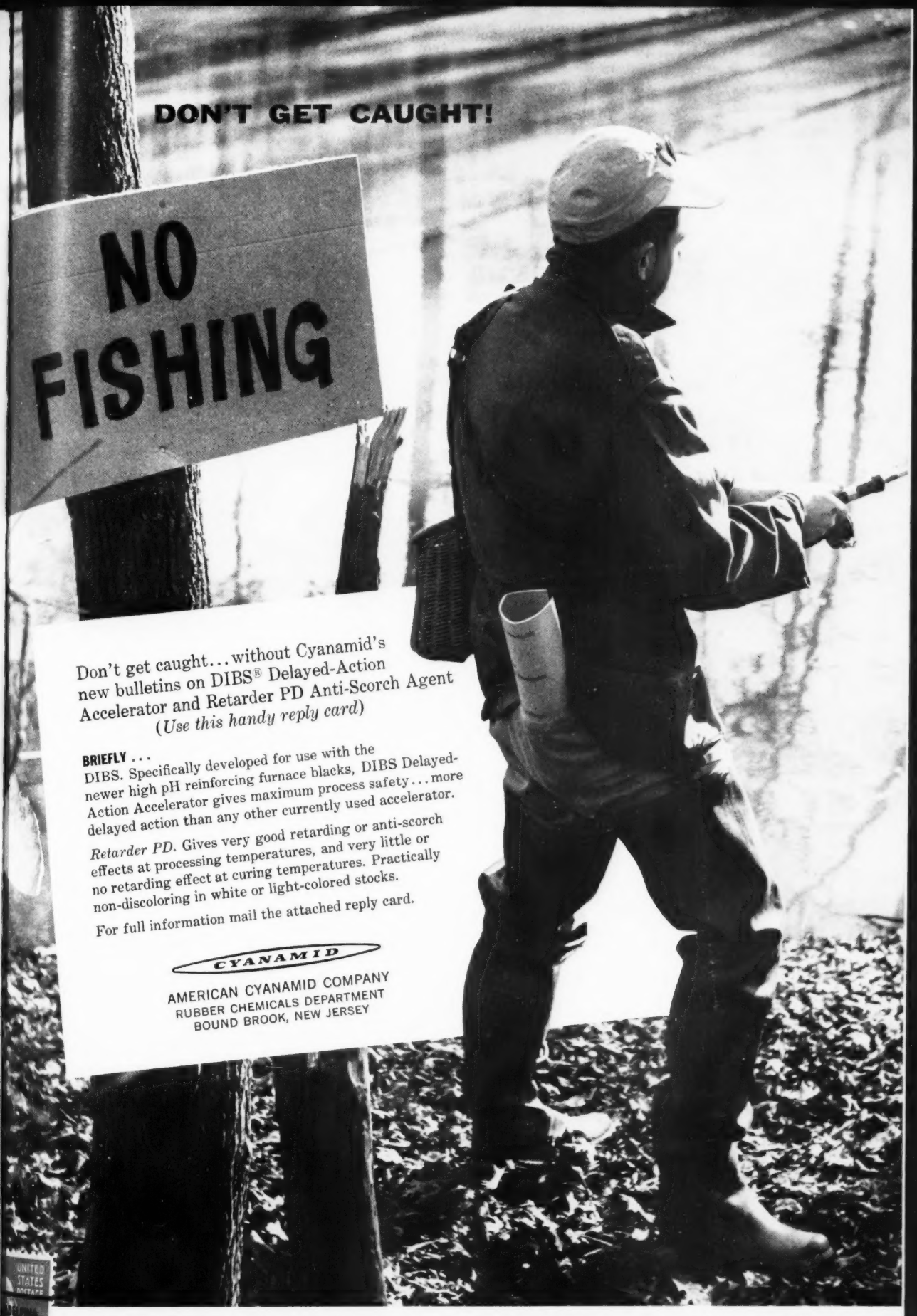
Some new records in the production, consumption, and export of synthetic rubbers were established in 1957, according to the regular monthly report of The Rubber Manufacturers Association, Inc., which in providing figures for December also included figures for the entire year. Consumption of synthetic rubber in the United States in 1957 totaled 928,359 long tons, a new high, and compares with the 874,394 long tons consumed in 1956 and the 894,899 long tons consumed in 1955 (the previous record year). Of the total new rubber consumed last year in the United States, synthetic rubber amounted to 63.3%.

Production of synthetic rubber in the U. S. in 1957 also reached a new yearly high of 1,118,308 long tons, as compared with the 1956 production of 1,079,574 tons. Two types of synthetic rubber, that is, SBR and neoprene, made new production records in 1957. SBR production of 907,551 tons and neoprene production of 110,721 tons were both higher than in any previous year.

In the field of exports, another new record, 201,477 tons shipped abroad, was established for synthetic rubbers, and here again SBR, with 156,789 tons exported, and neoprene, with 29,614 tons exported, established new highs in 1957. Exports of SBR and neoprene in 1956 amounted to 112,366 and 21,909 tons, respectively.

Consumption of synthetic rubbers in the U. S. according to types in 1957 saw SBR with 772,574 tons (a record high); neoprene with 75,471 tons (a record high); butyl with 55,313 tons; and nitrile rubbers with 25,001 tons.

All of these records were set in spite of reduced production and consumption in December in the U. S. Total new rubber consumption in December came to 104,640 tons, against



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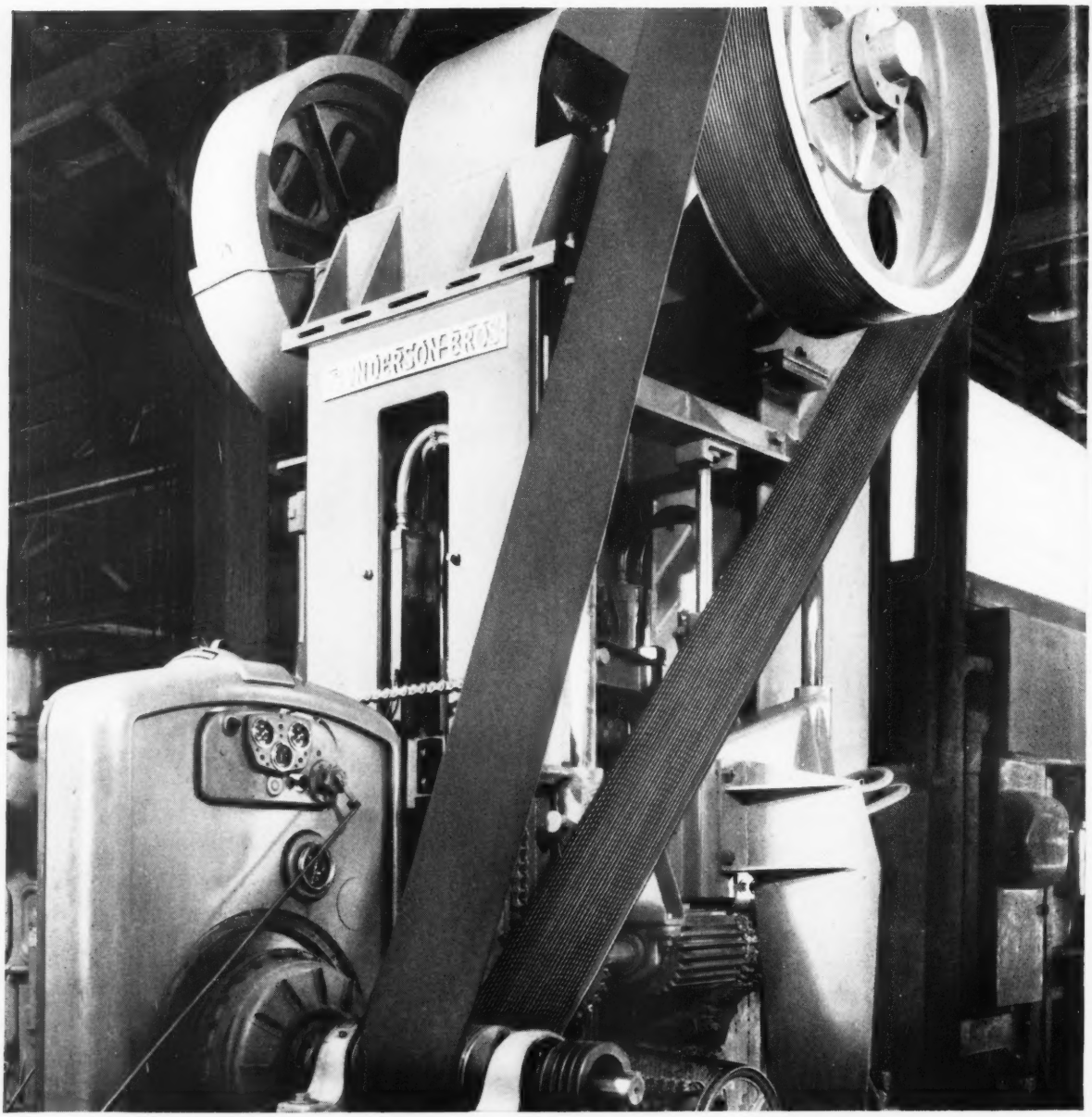

HIGH RATIO RETURNS—This giant portable gang saw is one of many used deep in the nation's forests for on-the-spot lumber operations. Manufactured by Gunderson Bros. Engineering Corp. of Portland, Oregon, the saw presented a special power transmission problem. Normally, the 7 to 1 speed ratio at which the saw had to operate would have required a heavy and cumbersome double-reduction belt drive with jack shaft. Gunderson Bros. solved this problem by utilizing a unique, multi-ribbed Poly-V® Belt, manufactured by Raybestos-Manhattan, Inc., Passaic, New Jersey. The unusual strength and traction of this specially designed belt permitted the necessary speed ratio with but a single drive and single belt. This compact drive unit not only reduced the overall weight of the machine, thus adding to its portability, but minimized vibration as well. In order to provide the great lateral strength, crack-resistance and body required in Poly-V® Belts, Raybestos-Manhattan uses Mount Vernon top cover fabrics.

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118,966 tons used in November. Synthetic rubber consumption in December amounted to 66,849 tons; in November it was 75,270 tons. Consumption by types for December, as compared with November figures, was as follows: SBR, 55,939 tons, against 62,484; neoprene, 5,416, against 6,194; butyl, 3,833, against 4,518; and nitrile, 1,661, against 2,074.

Production of synthetic rubbers in December was maintained at a surprisingly good level, however, with the amounts by types compared to November as follows: SBR, 85,240 tons, against 87,152 tons; neoprene, 9,568, against 9,976; butyl, 6,469, against 6,099; and nitrile, 2,495, against 2,803.

This synthetic rubber production was used to a greater extent in December in some instances by export shipments, which by types, compared to November figures, were as follows: SBR, 15,000 tons, against 12,000 tons; neoprene, 1,790, against 2,550; butyl, 1,105 tons, against 647 tons; and nitrile, 415, against 375.

It is also interesting to note that despite reduced business activity in December, stocks of synthetic rubber were reported at 197,712 long tons at the end of 1957, compared with 202,846 long tons on hand at the end of 1956. Inventories by types at the end of 1957, contrasted to 1956 figures, were as follows: SBR, 139,631 tons, against 151,934 tons; neoprene, 18,906, against 14,043; butyl, 31,427, against 28,685; and nitrile, 7,748, against 8,184.

The outlook for synthetic rubbers in 1958, according to both government and industry sources, is for a production of at least 1,150,000 long tons, a consumption of 960,000 long tons, and export approaching 300,000 long tons. This means that production, consumption, and export of all types of synthetic rubber are expected to be equal to or slightly greater than 1957 figures. Exports of SBR and neoprene are definitely expected to grow at a faster rate than domestic consumption, and the same may also be true for butyl and nitrile rubbers in 1958.

Scrap Rubber

The scrap rubber market for the year 1957 witnessed a period of stability at a comparatively low level. Although the reclaim business as a whole had fairly good business, it did not reflect itself in scrap purchases, as the policy of the industry had been to reduce inventories. Consumption of scrap by the reclaimers averaged approximately 20,000 tons per month in 1957; whereas consumption in 1956 had averaged 22,000 tons per month.

The entire scrap industry is undergoing a great change in methods of collection. Carload freight rates once again were increased by 7% during 1957, and indications are that they may be further increased in 1958. The main suppliers of scrap tires today are those dealers who are able to realize some return primarily from the selection of usable or recappable casings and by doing so handle scrap tires as a by-product.

It is reported and anticipated that the prospects for 1958 do not look any more enticing than those for 1957, and the utmost cooperation on the part of reclaimers and dealers is necessary to keep open the channels of supply through 1958.

During the December 15-January 15 period year-end influences resulted in keeping activity in the scrap market at a minimum. Some pickup began during the close of this period, particularly since Naugatuck was expected to resume accepting shipments beginning January 6. The Naugatuck reclaimer stopped accepting scrap shipments shortly before the holidays. Despite the lack of activity, scrap rubber prices were unchanged.

	Eastern Points	Akron, O.
	Per Net Ton	
Mixed auto tires	$8.00-$11.0	$12.00
S. A. G. truck tires	Nom.	15.50
Peeling, No. 1	Nom.	23.00
2	Nom.	20.00
3	Nom.	15.50
Tire buffings	Nom.	Nom.
	(¢ per Lb.)	
Auto tubes mixed	2.75	2.75
Black	6.25	6.25
Red	6.50	7.00
Butyl	3.50	3.75

Reclaimed Rubber

The reclaim business was reported to have slowed down considerably in the period between December 16 and January 15, and it was indicated that business in January had not shown any appreciable pickup. The major reclaimers did not expect any particular increase in reclaim usage until the automotive industry improves.

According to The Rubber Manufacturers Association, Inc., report, December production of reclaimed rubber reached 19,825 tons; while consumption was 19,150 long tons. During the year 1957, domestic production totaled 271,161 tons; consumption, 268,088 tons.

RECLAIMED RUBBER PRICES

Whole tire, first line	$0.11
Third line	.1025
Inner tube; black	.16
Red	.21
Butyl	.14
Light carcass	.22
Mechanical, light-colored, medium gravity	.155
Black, medium gravity	.085

The above list includes those items or classes only that determine the price basis of all derivative reclaim grades. Every manufacturer produces a variety of special reclaims in each general group separately featuring characteristic properties of quality, workability, and gravity, at special prices.

Industrial Fabrics

Trading in both cotton ducks and wide industrial fabrics generally remains practically dormant although specifications and deliveries against orders have been stepped up by some plastic coaters and rubberizers. This condition has been particularly evident in 40-inch and wider sheetings, trade sources report.

Trading in most wide fabrics and Army ducks remained slow.

INDUSTRIAL FABRICS

Drills	
59-inch 1.85 yd. ..... yd.	$0.335/.34
2.25-yd.	.285/.29
Ducks	
38-inch 1.78-yd. S.F. ....yd.	nom.
2.00-yd. D.F.	.30
51.5-inch, 1.35-yd. S.F. ..yd.	....
Hose and belting	.63
Osnaburgs	
40-inch 2.11-yd. ..... yd.	.2275
3.65-yd.	.1525
Raincoat Fabrics	
Printcloth, 38½-in., 64-60, 5.35-yd. ..... yd.	.1325
6.25-yd.	.1165
Sheeting, 48-inch, 4.17-yd. ..	.20
52-inch, 3.85-yd.	.2275
Chafer Fabrics	
14.40-oz./sq. yd. Pl. ....yd.	.73
11.65-oz./sq. yd. S.	.61
10.80-oz./sq. yd. S.	.6575
8.9-oz./sq. yd. S.	.67
Other Fabrics	
Headlining, 59-in., 1.65-yd., 2-ply ..... yd.	.41
64-inch, 1.25-yd., 2-ply ..	.59
Sateens, 58-inch, 1.32-yd. ..	.52/.525
58-inch, 1.21-yd.	.5675

Rayon

The December and annual 1957 data, including production, shipment, and stock data, on rayon and acetate filament yarn will be available in the next issue of RUBBER WORLD.

There were no reported price changes of rayon and filament yarns during the period under review (December 15-January 15).

RAYON PRICES

Tire Fabrics	
1100/490/2	$0.69 /$0.73
1650/908/2	.63 / .725
2200/980/2	.625/ .655
Tire Yarns	
High-Tenacity	
1100/ 490, 980	.50/ .64
1100/ 490	.59/ .63
1150/ 490, 980	.59/ .63
1165/ 480	.59/ .65
1230/ 490	.59/ .63
1650/ 720	.55/ .58
1650/ 980	.55/ .58
1875/ 980	.55/ .58
2200/ 960	.54/ .57
2200/ 980	.54/ .57
2200/1466	.64
4400/2934	.60
Super-High Tenacity	
1650/ 720	.58
1900/ 720	.58

STATISTICS of the RUBBER INDUSTRY

U.S.A. Imports and Production of Natural (Including Latex and Guayule) and Synthetic Rubber (in Long Tons)

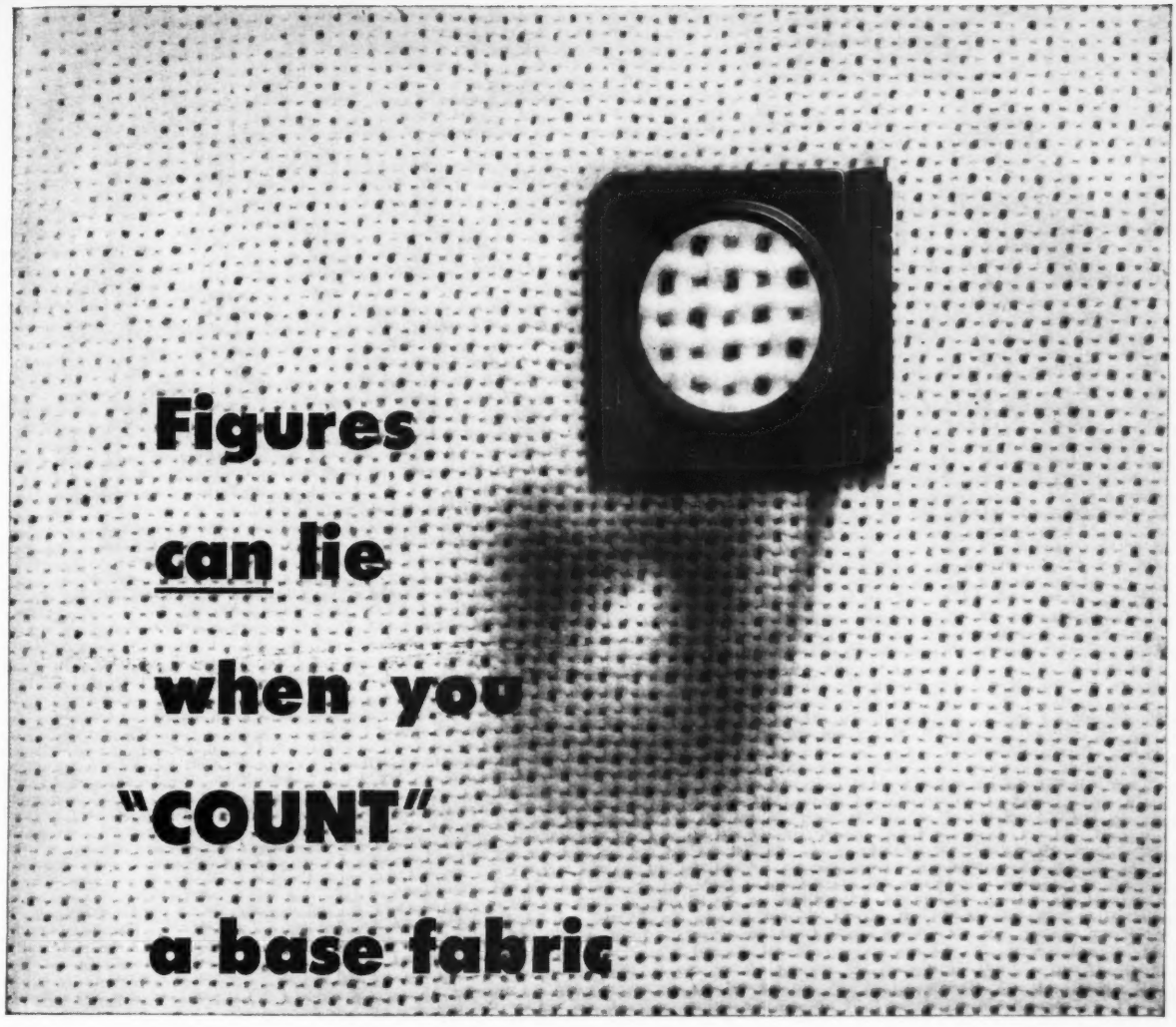
Year	Natural	GR-S	SBR-Types	Butyl	Neoprene	N-Type	Total Natural and Synthetic
1955	637,577	236,556	564,589	56,179	91,357	32,623	1,616,478
1956							
Jan.	58,803	....	76,028	6,896	8,207	3,125	153,059
Feb.	56,497	....	73,457	6,229	8,560	2,989	147,732
Mar.	52,749	....	77,812	5,686	7,822	3,663	147,732
Apr.	51,394	....	74,502	5,685	8,481	3,648	143,710
May	39,789	....	78,309	5,647	7,795	2,903	134,443
June	36,694	....	69,820	4,638	8,929	2,350	122,431
July	41,195	....	70,831	7,192	7,935	2,460	129,613
Aug.	40,367	....	70,122	7,118	7,769	2,141	127,517
Sept.	42,974	....	73,321	7,252	8,328	2,322	134,197
Oct.	52,638	....	70,690	7,018	8,144	2,973	141,463
Nov.	49,757	....	66,482	6,065	8,614	3,092	134,010
Dec.	57,653	....	76,056	6,496	8,828	2,921	151,954
Yr.-end adj.	+1,293	....	.....	....	....	....	+1,293
Total	579,217	....	877,430	75,922	99,412	34,567	1,667,841
1957							
Jan.	46,349	....	76,224	6,366	9,432	2,893	141,264
Feb.	37,487	....	66,023	5,664	9,004	2,894	121,072
Mar.	40,680	....	76,546	6,460	8,031	3,291	135,008
Apr.	59,896	....	65,706	5,890	8,902	2,408	142,802
May	52,566	....	77,542	6,145	9,235	2,561	148,049
June	30,290	....	68,297	4,474	9,678	2,538	137,553
July	44,760	....	67,796	1,972	8,591	2,592	125,711
Aug.	48,951	....	76,197	5,455	9,033	2,737	142,373
Sept.	47,937	....	75,872	6,113	9,726	2,826	142,474
Oct.	44,466	....	87,709	6,085	9,545	3,062	150,867
Nov.*	....	....	87,152	6,099	9,976	2,803	....

* Preliminary. Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U.S.A. Consumption of Natural (Including Latex) and Synthetic Rubber (Long Tons)

Year	Natural	GR-S	SBR Types	Butyl	Neoprene	N-Type	Total Natural and Synthetic
1955	634,800	234,963	507,034	53,991	72,876	26,035	1,529,699
1956							
Jan.	53,751	....	65,375	4,223	6,684	2,198	132,231
Feb.	50,285	....	62,366	4,155	6,430	2,289	125,525
Mar.	50,040	....	64,458	4,515	6,542	2,373	127,928
Apr.	47,446	....	62,179	4,228	6,125	2,150	122,128
May	48,342	....	63,629	4,285	6,379	2,103	124,738
June	43,638	....	56,390	4,026	5,536	1,864	111,454
July	38,353	....	48,907	3,316	4,435	1,538	96,549
Aug.	46,700	....	59,756	4,102	6,554	2,125	119,237
Sept.	44,179	....	57,135	4,044	6,057	1,969	113,384
Oct.	52,188	....	67,399	4,780	7,478	2,366	134,211
Nov.	42,946	....	58,692	4,093	6,676	2,065	114,472
Dec.	45,220	....	60,742	3,814	5,956	1,893	117,625
Yr.-end adj.	−1,000	....	−3,000	....	....	+1,000	−3,000
Total	562,088	....	724,028	49,581	74,852	25,933	1,436,482
1957							
Jan.	52,631	....	70,978	5,028	7,237	2,247	138,121
Feb.	46,427	....	64,322	4,581	6,235	2,122	123,687
Mar.	48,263	....	67,853	4,998	6,559	2,240	129,913
Apr.	45,368	....	63,280	4,651	6,295	2,129	121,723
May	46,385	....	66,774	4,902	6,441	2,125	126,753
June	41,282	....	58,479	4,198	5,816	1,963	111,738
July	39,683	....	58,021	4,146	5,231	1,646	108,727
Aug.	44,846	....	66,089	4,461	6,502	2,220	124,118
Sept.	43,527	....	64,505	4,654	6,351	2,141	120,930
Oct.	48,782	....	73,850	5,343	7,194	2,433	137,058
Nov.*	43,696	....	62,484	4,518	6,194	2,074	....

* Preliminary. Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.



Yarns-per-inch "count" of grey fabric can be completely misleading because of changes produced by finishing and subsequent processing!

"Count" tells how open or tight a woven fabric is. The number of yarns per inch of cloth affects absorbency, adhesion, permeability, strength, bulk, flexibility and other characteristics related to fabric-reinforced plastic or rubber products. But if count is taken in the "grey," dimensional changes caused by pre-shrinking, heat-setting, calendering, napping, singeing, pre-dipping or other processes will not have been considered—and end-product performance may suffer.

Of course, thread count is but one of many factors affecting fabric performance. When your base fabric is one of the wide variety provided by Wellington Sears for coating, laminating, combining and rubberizing, you know that everything has been considered in the light of *your specific need*. And moreover you know that a century of experience is working for you, to anticipate and help solve your basic fabric problems. For free booklet, "Fabrics Plus," write Dept. H-2, Wellington Sears Co., 65 Worth St., New York 13, N. Y.

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U.S.A. Stocks of Latex

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1956						
Jan.	16,059	6,522	1,093	1,906	9,521	25,580
Feb.	16,735	7,011	1,162	1,943	10,116	26,851
Mar.	18,309	6,867	1,097	2,340	10,304	28,613
Apr.	21,384	7,415	1,163	2,272	10,850	32,234
May	21,234	7,516	1,218	2,194	10,928	32,162
June	21,033	7,447	1,328	2,086	10,861	31,894
July	19,952	7,288	1,109	2,009	10,406	30,358
Aug.	18,099	6,402	1,076	1,703	9,181	27,280
Sept.	15,403	6,625	1,328	1,523	9,476	24,879
Oct.	12,322	5,703	1,263	1,680	8,646	20,968
Nov.	11,148	6,282	1,233	1,939	9,454	20,602
Dec.	12,262	7,327	1,421	‡2,217	‡10,965	‡23,227
1957						
Jan.	11,831	7,191	1,329	1,936	10,456	22,287
Feb.	9,940	7,415	1,169	2,051	10,635	20,575
Mar.	10,173	7,689	1,170	2,157	11,016	21,189
Apr.	12,064	8,096	1,183	1,836	11,115	23,179
May	11,733	7,885	1,407	1,710	11,002	22,735
June	10,931	8,139	1,377	2,001	11,517	22,448
July	12,073	8,045	1,296	1,953	11,294	23,367
Aug.	13,535	7,997	1,309	1,545	10,851	24,386
Sept.	12,315	7,566	1,141	1,700	10,407	23,722
Oct.	12,399	7,254	1,142	1,723	10,119	22,518
Nov.†	12,315	7,764	1,181	1,487	10,432	22,747

Source: Bureau of the Census, Industry Division, Chemicals Branch, United State Department of Commerce. *Includes SBR-Typeas. †Preliminary. ‡Includes 200 long tons for year-end adjustment.

U.S.A. Stocks of Synthetic Rubber

(Long Tons)

Year	SBR-Types	Butyl	Neoprene	N-Type	Total
1956					
Jan.	111,263	12,303	11,850	6,316	141,732
Feb.	114,389	13,027	11,888	6,602	145,906
Mar.	118,063	13,458	12,037	7,437	150,995
Apr.	121,054	14,071	12,042	8,243	155,370
May	127,163	15,253	11,478	8,788	162,682
June	133,570	15,744	12,927	8,955	171,196
July	145,601	18,899	15,084	9,229	188,813
Aug.	148,176	21,267	14,540	8,503	192,486
Sept.	154,841	23,862	14,055	8,035	200,793
Oct.	151,646	25,734	12,841	7,567	197,788
Nov.	151,143	26,998	13,459	7,734	199,334
Dec.	151,934	28,685	14,043	†8,184	†202,846
1957					
Jan.	143,177	29,810	13,073	7,664	193,724
Feb.	134,587	29,951	12,705	7,565	184,808
Mar.	131,255	30,814	11,949	7,795	181,813
Apr.	122,764	31,536	12,064	7,247	173,611
May	121,638	31,812	13,010	6,981	173,441
June	120,694	31,569	13,822	7,085	173,170
July	113,143	28,208	15,172	7,125	163,648
Aug.	111,962	28,339	14,603	6,784	161,688
Sept.	109,417	29,132	14,751	7,207	160,507
Oct.	113,382	29,008	15,181	7,134	164,705
Nov.*	125,141	29,857	16,544	7,306	178,848

Source: Bureau of Census, Industry Division Chemicals Branch, United States Department of Commerce. *Preliminary. †Includes 250 long tons, year-end adjustment.

U.S.A. Rubber Industry Sales and Inventories

(Million of Dollars)

	Value of Sales*.				Manufacturers' Inventories*			
	1954	1955	1956	1957	1954	1955	1956	1957
Jan.	348	424	415	496	844	790	935	1,047
Feb.	351	440	445	495	857	782	970	1,036
Mar.	388	466	451	476	849	805	979	1,030
Apr.	375	445	445	490	812	784	970	1,031
May	357	465	464	481	810	810	985	1,024
June	377	465	450	458	829	850	975	1,027
July	374	471	459	514	784	853	987	1,045
Aug.	377	456	436	481	761	863	1,007	1,074
Sept.	334	456	429	462	804	874	1,007	1,031
Oct.	332	447	454	...	838	902	1,022	...
Nov.	388	482	463	...	819	935	1,024	...
Dec.	407	465	461	...	929	934	998	...
Total	4,368	5,493	5,372	...	Av. 831	845	988	...

Source: Office of Business Economics, U. S. Department of Commerce.
*Adjusted for seasonal variation.

U.S.A. Exports of Synthetic Rubber

(Long Tons)

Year	SBR-Types	Butyl	Neoprene	N-Type	Total
1956					
Jan.	7,550	815	1,757	506	10,628
Feb.	9,018	1,624	1,521	449	12,612
Mar.	10,804	764	1,500	522	13,590
Apr.	10,271	374	1,917	587	13,149
May	10,864	743	2,142	443	14,192
June	9,558	746	2,088	548	12,940
July	9,038	523	1,994	433	11,988
Aug.	9,607	654	2,268	274	12,803
Sept.	8,804	439	2,824	403	12,470
Oct.	6,795	454	1,013	618	8,880
Nov.	4,789	247	1,056	551	6,643
Dec.	15,268	1,316	1,829	860	19,273
Total	112,366	8,699	21,909	6,194	149,168
1957					
Jan.	13,989	207	2,500	540	17,236
Feb.	13,353	439	2,505	482	16,779
Mar.	13,664	1,014	2,466	781	17,925
Apr.	10,625	372	2,244	620	13,861
May	12,208	603	2,480	517	15,808
June	13,886	762	2,315	492	17,455
July	14,444	1,169	3,426	631	19,670
Aug.	13,795	758	2,786	478	17,817
Sept.	11,625	540	1,964	396	14,525
Oct.	12,200	1,261	2,588	467	16,516

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U.S.A. Consumption of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1956						
Jan.	6,776	5,858	772	670	7,300	14,076
Feb.	6,399	5,913	787	730	7,430	13,829
Mar.	6,438	5,888	729	781	7,398	13,836
Apr.	5,693	4,923	741	692	6,356	12,049
May	5,239	4,745	778	691	6,214	11,453
June	5,171	4,350	637	657	5,644	10,815
July	4,855	3,731	562	466	4,759	9,614
Aug.	6,374	5,055	816	698	6,569	12,943
Sept.	6,233	4,937	692	699	6,328	12,561
Oct.	7,825	6,175	795	681	7,651	15,476
Nov.	6,431	5,406	723	659	6,788	13,219
Dec.	6,666	5,399	701	710	6,810	13,476
Yr.-end adj.	−1,000	+3,000	....	+800	+3,800	+2,800
Total	73,100	65,380	8,733	8,934	83,047	156,147
1957						
Jan.	6,994	6,288	856	841	7,985	14,979
Feb.	6,398	5,894	758	708	7,360	13,758
Mar.	7,081	6,370	784	799	7,953	15,034
Apr.	6,434	5,554	772	710	7,036	13,470
May	5,867	5,114	814	731	6,659	12,526
June	5,445	4,790	736	610	6,136	11,681
July	5,180	4,269	677	480	5,426	10,606
Aug.	6,499	5,758	784	823	7,365	13,864
Sept.	6,645	5,676	712	753	7,141	13,786
Oct.	7,250	6,556	788	857	8,201	15,451
Nov.†	6,735	5,661	735	599	6,995	13,730

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce. † Preliminary. *Includes SBR-Types.

U.S.A. Production of Cotton, Rayon, and Nylon Tire Fabrics

	Cotton and Nylon*		Rayon Tire Cord		Total All Tire Cord and Fabrics
	Cotton Chafer Fabrics and Other Tire Fabrics	Cotton and Nylon Tire Cord and Fabrics	Woven	Not Woven	
1956	40,660	6,157	248,629	84,033	449,479
1957					
Jan.-Mar.	11,028	20,676	69,610	21,872	124,297
Apr.-June	10,456	24,852	63,195	16,037	115,418
July-Sept.	9,102	24,852	54,968	10,509	100,046

* Cotton and nylon figures combined to avoid disclosing data for individual companies.
Source: Bureau of the Census, United States Department of Commerce.

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Sublimed White Lead	Sublimed Blue Lead

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Over the years, the technological demands of industry have caused this company, in its development and expansion, to devote its operations exclusively to the conversion of cotton, rayon, nylon and other synthetic fibers into decorative and industrial flock. The new name, therefore, is logical and appropriate.

Personnel, policies, facilities and location remain unchanged. Our aim, as always, will be to strive continually for still better quality of product and service to the many customers and friends in the plastics, packaging, paper, rubber, textile and industrial finishing fields who have helped to make this company the country's largest producer of flock.

U.S.A. Imports and Production of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1956						
Jan.	10,328	6,885	848	919	8,652	18,980
Feb.	7,965	6,943	930	827	8,700	16,665
Mar.	7,800	5,911	782	1,158	7,851	15,651
Apr.	6,995	6,097	969	866	7,922	14,917
May	5,731	4,966	939	614	6,519	12,250
June	5,006	4,776	907	543	6,226	11,232
July	3,522	4,241	444	731	5,416	8,938
Aug.	4,715	4,902	882	684	6,468	11,183
Sept.	2,790	5,723	1,180	938	7,841	10,631
Oct.	5,738	6,122	908	1,183	8,213	13,951
Nov.	4,761	6,053	886	1,175	8,114	12,875
Dec.	6,661	7,143	967	1,012	9,122	15,783
Yr.-end adj.	—294	....	....	....	....	—294
Total	71,718	69,762	10,642	10,650	91,054	162,772
1957						
Jan.	6,460	7,228	905	960	9,093	15,553
Feb.	4,342	6,481	724	1,035	8,240	12,582
Mar.	5,856	7,227	924	1,127	9,278	15,134
Apr.	8,812	6,306	976	881	8,163	16,975
May	5,794	5,495	1,082	933	7,510	13,304
June	4,809	5,251	819	886	6,956	11,765
July	6,243	4,646	572	844	6,062	12,305
Aug.	6,834	6,816	874	608	8,298	15,132
Sept.	7,417	5,649	917	1,285	7,851	15,268
Oct.	5,917	6,876	885	1,133	8,894	14,811
Nov.†	....	6,515	1,021	994	8,530	....

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.
* Includes SBR-Types. † Preliminary.

U.S.A. New Supply, Consumption, Exports, and Stock of Reclaimed Rubber

(Long Tons)

Year	New Supply	Consumption	Exports	Stocks
1954	258,101	249,049	10,232	30,746
1955	326,649	312,781	13,988	31,498
1956				
Jan.	26,205	25,827	1,382	31,640
Feb.	27,108	25,571	1,115	31,875
Mar.	28,468	26,176	1,163	33,326
Apr.	26,933	23,999	1,179	34,360
May	25,485	23,560	1,297	34,863
June	22,153	20,560	1,264	35,647
July	19,776	18,099	952	35,703
Aug.	21,724	21,498	1,076	35,512
Sept.	22,368	20,242	1,015	36,527
Oct.	26,318	23,946	1,298	37,904
Nov.	20,009	20,832	1,189	36,063
Dec.	20,673	20,737	902	34,969
Year-end. adj.	.....	—500	....	.....
Total	287,220	270,547	13,832	34,969
1957				
Jan.	25,103	24,053	1,288	34,552
Feb.	21,896	22,773	1,263	32,010
Mar.	25,088	24,633	1,298	30,975
Apr.	22,878	23,145	1,201	30,258
May	24,884	23,816	1,277	29,847
June	22,402	21,352	1,083	30,378
July	20,444	19,676	757	29,972
Aug.	20,423	22,429	917	28,521
Sept.	19,892	21,704	714	25,983
Oct.	26,407	24,925	1,230	27,171
Nov.*	22,031	20,432	....	27,801

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.
* Preliminary.

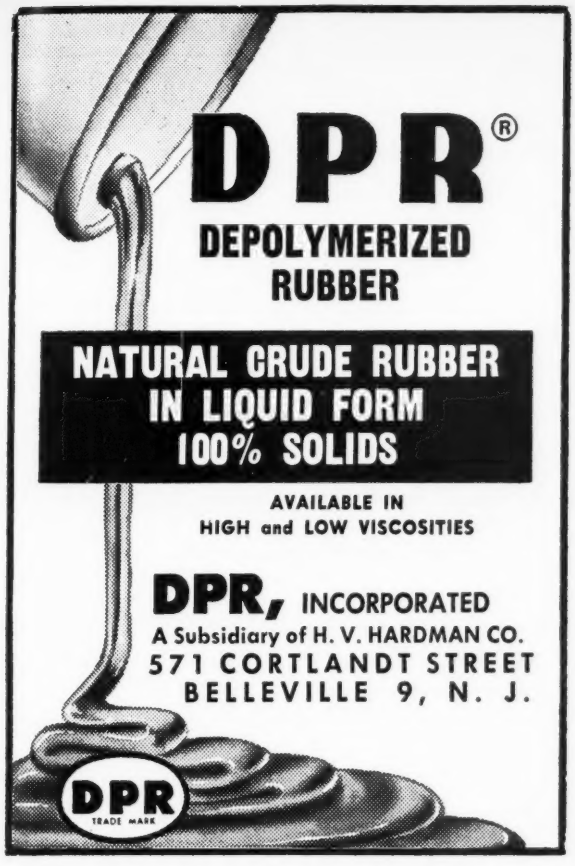
Carbon Black Statistics — First Nine Months, 1957

Furnace blacks are classified as follows: SRF, Semi-reinforcing furnace black; HMF, high modulus furnace black; FEF, fast-extruding furnace black; HAF, high abrasion furnace black; SAF, super abrasion furnace black; ISAF, intermediate super abrasion furnace black.

(Thousands of Pounds)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
Production											
Furnace types											
Thermal	13,200	10,064	12,147	13,533	14,395	11,989	11,680	10,797	10,432	11,814	9,938
SRF	26,328	21,623	27,167	24,726	24,216	21,406	21,114	24,298	20,995	23,981	23,684
HMF	11,112	10,898	10,292	10,105	11,052	10,563	11,825	10,244	10,674	11,023	10,492
FEF	17,125	13,340	20,439	18,621	19,809	17,240	18,174	18,020	19,377	18,474	19,577
HAF	42,186	34,730	41,201	35,038	40,048	36,910	34,655	47,879	37,872	39,042	40,596
SAF, ISAF	16,348	15,246	18,864	15,213	15,512	16,488	18,747	15,681	17,828	17,129	14,368
Total furnace	126,299	105,901	130,110	117,236	125,032	114,596	116,195	126,919	117,178	121,463	118,655
Contact types	31,563	27,792	30,726	29,879	30,733	29,497	30,556	30,268	28,389	29,278	29,367
Totals	157,862	133,693	160,836	147,115	155,765	144,093	146,751	157,187	145,567	150,741	148,022
Shipments											
Furnace types											
Thermal	13,499	11,726	12,442	12,556	11,488	9,931	10,993	10,930	11,310	13,517	11,624
SRF	25,864	24,246	37,063	19,359	21,453	21,771	22,343	21,807	20,908	26,549	23,905
HMF	10,517	10,273	13,449	9,584	9,695	10,314	9,999	10,840	11,983	10,900	11,224
FEF	21,080	17,685	26,129	14,441	18,918	14,424	17,199	18,334	17,674	20,776	18,155
HAF	38,446	37,049	55,187	30,348	40,524	33,826	36,650	40,299	38,196	43,895	42,517
SAF, ISAF	15,978	14,692	20,562	15,622	15,505	14,225	15,882	17,529	16,538	17,381	16,191
Total furnace	125,384	115,671	164,832	101,910	117,583	104,491	113,066	119,739	116,609	133,018	123,616
Contact types	35,688	32,565	42,196	28,276	25,916	24,989	26,596	26,898	27,443	31,130	27,835
Totals	161,072	148,236	207,028	130,186	143,499	129,480	139,662	146,637	144,052	164,148	151,451
Producers' Stocks, End of Period											
Furnace types											
Thermal	18,478	16,816	16,521	17,498	20,405	22,463	23,150	23,017	22,139	20,436	18,750
SRF	76,472	73,781	63,885	69,252	72,015	71,650	70,421	72,912	72,999	70,431	70,210
HMF	20,163	20,788	17,631	18,152	19,509	19,758	21,584	20,988	19,679	19,802	19,070
FEF	29,362	25,006	19,316	23,496	24,387	27,203	28,178	27,864	29,567	27,265	28,687
HAF	60,018	57,699	43,713	48,403	47,927	51,011	49,016	56,596	56,272	51,419	49,498
SAF, ISAF	56,740	57,373	55,675	55,266	55,273	57,536	60,401	58,553	59,843	59,591	57,768
Total furnace	261,233	251,463	216,741	232,067	239,516	249,621	252,750	259,930	260,499	248,944	243,983
Contact types	73,385	68,612	57,142	58,745	63,562	68,070	72,030	75,400	76,346	74,494	76,026
Totals	334,618	320,075	273,883	290,812	303,078	317,691	324,780	335,330	336,845	323,438	320,009
Exports											
Furnace types											
Total furnace	18,605	23,722	23,357	30,550	26,581	19,359	16,864	19,501	21,058	24,934	—
Contact types	18,306	21,218	15,888	19,832	17,222	13,045	13,538	12,699	14,240	12,006	—
Totals	36,911	44,940	39,245	50,382	43,803	32,404	30,402	32,200	35,298	36,940	—

Source: Bureau of Mines, United States Department of the Interior, Washington, D. C.



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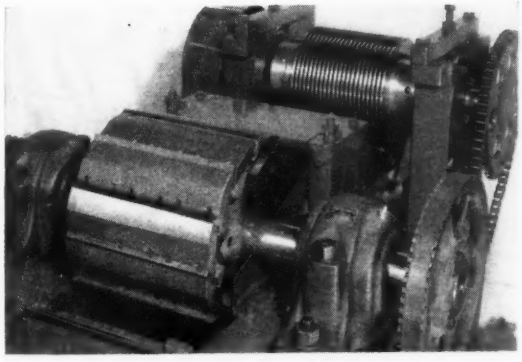

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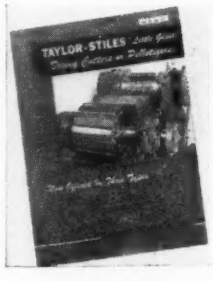

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World Consumption of Natural Rubber

(1,000 Long Tons)

Year	United States	Eastern Europe and China	United Kingdom	Other Foreign	Total Foreign	Grand* Total
1956						
Jan.	53.7	19.1	21.7	68.8	109.6	162.5
Feb.	50.2	28.2	17.9	63.2	109.3	160.0
Mar.	50.0	23.1	16.0	71.4	110.5	160.0
Apr.	47.4	22.7	18.4	70.1	111.2	160.0
May	48.3	27.0	14.5	68.6	110.1	157.5
June	43.6	30.0	16.1	73.8	119.9	162.5
July	38.3	23.4	14.7	70.9	109.0	147.5
Aug.	46.6	13.9	10.3	64.9	89.1	135.0
Sept.	44.1	25.1	14.5	73.5	113.1	157.5
Oct.	52.1	17.5	18.8	78.3	114.6	167.5
Nov.	43.0	32.0	15.7	72.1	119.8	162.5
Dec.	45.1	34.0	14.3	66.5	114.8	160.0
Total	562.1	295.0	192.8	841.7	1,330.4	1,892.5
1957						
Jan.	52.6	13.0	14.4	74.9	102.3	155.0
Feb.	46.4	19.9	14.5	72.7	107.1	152.5
Mar.	48.3	23.6	17.6	72.7	113.9	162.5
Apr.	45.4	32.2	13.6	76.6	122.4	167.5
May	46.5	10.3	14.5	79.3	104.1	150.6
June	41.3	25.4	17.2	74.8	117.4	158.7
July	39.7	25.3	14.0	...	....	152.5
Aug.	44.9	28.0	9.7	...	....	150.0
Sept.	43.5	...	18.1	...	....	152.5

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce; and Secretariat of the Interior Rubber Study Group. *Estimaated.

World Production of Natural Rubber

(1,000 Long Tons)

Year	Malaya Estate	Malaya Native	Indonesia Estate	Indonesia Native	All Other	Total
1956						
Jan.	32.6	26.5	23.7	17.7	49.5	150.0
Feb.	27.6	24.3	23.0	21.0	41.6	137.5
Mar.	28.5	22.5	21.5	16.9	43.0	132.5
Apr.	26.7	21.7	20.0	46.1	40.4	155.0
May	23.5	19.8	18.0	38.4	42.9	142.5
June	29.5	23.2	21.9	25.7	47.0	147.5
July	30.8	23.9	21.3	41.3	47.6	165.0
Aug.	30.3	23.0	20.3	64.0	49.9	187.5
Sept.	30.2	21.9	21.3	28.8	42.7	145.0
Oct.	30.5	22.5	22.0	34.0	58.5	167.5
Nov.	28.4	21.3	21.9	44.0	54.1	170.0
Dec.	34.7	24.2	23.0	49.2	56.1	187.5
Total	353.0	274.4	259.0	427.8	532.9	1,887.5
1957						
Jan.	36.1	27.3	23.8	22.7	45.1	155.0
Feb.	27.1	22.1	20.6	16.4	38.8	125.0
Mar.	26.0	21.1	19.7	46.1	52.2	165.0
Apr.	26.6	22.5	19.6	41.6	39.8	150.0
May	27.2	18.3	18.1	30.4	43.5	137.5
June	29.7	21.6	20.4	29.5	43.8	145.0
July	32.5	24.1	21.0	65.9	46.5	192.5
Aug.	33.0	23.2	21.8	52.4	44.8	175.0
Sept.	31.5	21.4	21.8	37.7	35.0	157.5

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce; Secretariat of the International Rubber Study Group.

World Consumption of Synthetic Rubber*

(1,000 Long Tons)

Year	U.S.A.	Canada	United Kingdon	Total† Continent of Europe	World† Grand Total
1956					
Jan.	78.5	4.0	3.1	9.0	100.0
Feb.	75.2	4.1	3.1	9.0	95.0
Mar.	78.3	4.1	3.1	9.0	97.5
Apr.	73.7	4.4	3.6	8.8	97.5
May	76.4	4.5	3.2	8.5	97.5
June	67.8	4.0	3.6	9.5	90.0
July	58.2	3.7	2.9	8.8	80.0
Aug.	72.5	3.3	2.3	7.5	90.0
Sept.	69.2	3.9	3.2	9.0	90.0
Oct.	82.0	4.2	4.1	10.8	105.0
Nov.	71.5	4.3	3.9	10.5	95.0
Dec.	73.3	3.8	3.6	9.8	97.5
Total	877.3	48.4	39.5	110.5	1,135.0
1957					
Jan.	85.5	4.4	3.7	11.5	110.0
Feb.	77.9	4.2	3.9	11.3	102.5
Mar.	81.7	4.3	5.4	11.5	110.0
Apr.	76.4	4.2	4.0	12.3	102.5
May	80.2	4.7	4.8	12.5	107.5
June	70.5	4.2	5.5	12.3	97.5
July	69.0	3.5	4.3	12.8	89.6
Aug.	79.3	2.8	3.0	10.3	95.4
Sept.	77.4	3.7	6.7	12.8	100.6

Source: Secretariat of the International Rubber Study Group; Bureau of the Census, Industry Division, Chemical Branch, U. S. Department of Commerce. *Includes latices. †Figures estimated or partly estimated.

World Production of Synthetic Rubber

(1,000 Long Tons)

Year	U.S.A.	Canada	Germany	Total
1956				
Jan.	93.5	9.7	1.0	104.3
Feb.	90.5	8.2	1.0	99.7
Mar.	94.4	10.3	1.1	105.8
Apr.	91.6	10.3	1.0	102.8
May	93.7	10.6	1.0	105.3
June	85.3	10.4	0.6	96.3
July	85.0	8.7	1.0	97.7
Aug.	86.5	10.2	0.9	97.6
Sept.	90.6	10.7	0.8	102.1
Oct.	88.2	10.7	0.8	99.7
Nov.	83.5	10.3	0.8	94.7
Dec.	93.8	10.6	0.8	105.2
Total	1,079.6	120.7	10.7	1,211.0
1957				
Jan.	94.3	11.1	0.9	106.2
Feb.	83.2	9.8	1.1	94.1
Mar.	93.9	11.1	1.1	106.1
Apr.	82.3	11.0	1.0	94.3
May	95.0	11.5	0.8	107.3
June	84.4	11.3	1.1	96.8
July	81.0	10.1	0.8	91.9
Aug.	93.4	11.0	1.1	....
Sept.	94.5	10.9	...	....

Source: Secretariat of the International Rubber Study Group; and Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U.S.A. Synthetic Rubber Industry, Wages, Hours

Year	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings
1956			
Oct.	107.52	42.0	2.56
Nov.	103.57	41.1	2.52
Dec.	107.33	41.6	2.58
1957			
Jan.	106.30	41.2	2.58
Feb.	104.19	40.7	2.56
Mar.	104.86	40.8	2.57
Apr.	103.94	40.6	2.56
May	105.93	40.9	2.59
June	103.88	39.8	2.61
July	108.75	41.2	2.64
Aug.	109.34	40.8	2.68
Sept.	108.14	40.5	2.67

Source: BLS, United States Department of Labor.

U.S.A. Automotive Inner Tubes

(Thousands of Units)

Year	Shipments: Original Equipment	Shipments: Replacement	Shipments: Export	Shipments: Total	Production	Inventory End of Period
1956	3,101	32,358	1,041	36,499	34,407	6,109
1957						
Jan.	274	3,263	72	3,608	2,918	6,294
Feb.	267	2,964	61	3,292	3,362	5,960
Mar.	240	3,057	100	3,397	3,822	6,540
Apr.	311	2,708	85	3,104	3,428	6,969
May	301	2,827	86	3,214	3,548	7,422
June	275	3,141	69	3,485	3,025	6,946
July	258	3,364	86	3,708	2,941	6,287
Aug.	243	3,358	81	3,683	3,134	5,966
Sept.	213	3,180	90	3,483	3,365	6,174
Oct.	242	2,809	121	3,172	3,764	6,909
Nov.	259	2,468	65	2,792	2,585	6,250

Source: The Rubber Manufacturers Association, Inc.

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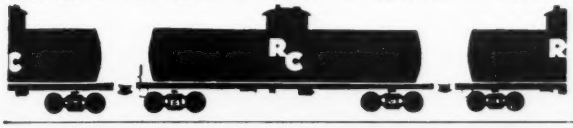

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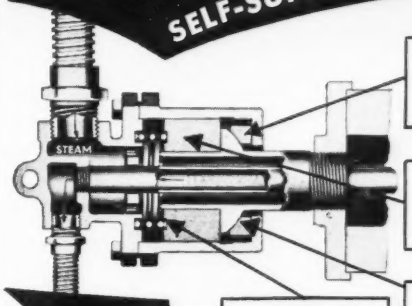
SELF-SUPPORTING TYPE



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4. **SPRING** — For initial seating only. In operation joint is pressure sealed.

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U.S.A. Automotive Pneumatic Casings

(Thousands of Units)

	Shipments					
	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
Passenger Car						
1956						
Jan. ..	2,958	4,040	66	7,064	7,661	16,546
Feb. ..	2,919	3,387	90	6,396	7,571	17,701
Mar. ..	3,027	4,372	65	7,464	7,812	18,096
Apr. ..	2,787	4,994	67	7,847	7,530	17,649
May ..	2,349	5,203	65	7,617	7,628	17,714
June ..	2,162	5,659	64	7,885	6,600	16,443
July ..	2,471	5,482	73	8,026	5,669	14,088
Aug. ..	1,953	5,359	77	7,389	6,897	13,578
Sept. ..	1,262	4,427	70	5,758	6,647	14,468
Oct. ..	2,530	3,854	87	6,471	7,526	15,607
Nov. ..	3,179	3,255	62	6,496	6,580	15,596
Dec. ..	3,277	3,220	90	6,587	7,425	16,494
Total	30,874	42,411	876	85,000	95,546	
1957						
Jan. ..	3,192	4,521	100	7,812	8,296	16,978
Feb. ..	3,017	4,453	68	7,538	8,047	17,376
Mar. ..	3,051	4,875	80	8,006	8,629	18,065
Apr. ..	2,809	5,218	78	8,104	7,878	17,821
May ..	2,831	5,166	60	8,057	8,313	18,050
June ..	2,623	5,532	63	8,217	7,462	17,322
July ..	2,719	5,826	65	8,611	7,449	16,097
Aug. ..	2,886	5,675	66	8,627	7,801	15,348
Sept. ..	1,398	5,096	70	6,564	7,535	16,310
Oct. ..	2,298	4,392	88	6,778	8,437	17,998
Nov. ..	3,179	3,250	62	6,491	6,575	15,596
Truck and Bus						
1956						
Jan. ..	444	629	65	1,139	1,318	2,971
Feb. ..	424	565	88	1,077	1,326	3,232
Mar. ..	439	662	62	1,163	1,382	3,465
Apr. ..	430	767	74	1,271	1,303	3,483
May ..	421	777	65	1,264	1,358	3,582
June ..	372	968	65	1,404	1,329	3,504
July ..	362	837	73	1,272	1,073	3,306
Aug. ..	349	820	86	1,254	1,154	3,217
Sept. ..	291	811	92	1,194	1,153	3,180
Oct. ..	378	849	78	1,305	1,273	3,168
Nov. ..	337	626	59	1,022	1,060	3,207
Dec. ..	301	583	76	961	1,130	3,378
Total	4,548	8,894	883	14,326	14,589	
1957						
Jan. ..	305	678	83	1,066	1,208	3,512
Feb. ..	344	598	59	1,001	1,122	3,633
Mar. ..	330	704	74	1,107	1,136	3,678
Apr. ..	438	771	49	1,277	1,072	3,486
May ..	399	620	74	1,094	1,178	3,580
June ..	370	715	64	1,149	1,027	3,461
July ..	349	819	61	1,229	994	3,219
Aug. ..	328	813	65	1,206	1,117	3,129
Sept. ..	290	805	63	1,158	1,105	3,083
Oct. ..	322	959	94	1,375	1,271	2,987
Nov. ..	337	626	59	1,021	1,060	3,207
Total Automotive						
1956						
Jan. ..	3,402	4,669	131	8,203	8,979	19,517
Feb. ..	3,343	3,953	178	7,473	8,897	20,934
Mar. ..	3,466	5,034	127	8,627	9,193	21,562
Apr. ..	3,217	5,761	141	9,119	8,834	21,132
May ..	2,770	5,980	130	8,880	8,987	21,296
June ..	2,533	6,627	129	9,289	7,930	19,947
July ..	2,833	6,319	146	9,298	6,741	17,394
Aug. ..	2,303	6,179	163	8,644	8,050	16,795
Sept. ..	1,553	5,238	162	6,952	7,800	17,648
Oct. ..	2,908	4,703	165	7,776	8,799	18,775
Nov. ..	3,516	3,881	121	7,518	7,641	18,803
Dec. ..	3,579	3,803	166	7,548	8,556	19,872
Total	35,423	62,147	1,759	99,327	100,407	
1957						
Jan. ..	3,496	5,199	183	8,878	9,504	20,490
Feb. ..	3,361	5,052	127	8,539	9,169	21,009
Mar. ..	3,381	5,579	154	9,114	9,766	21,743
Apr. ..	3,246	5,989	146	9,381	8,950	21,308
May ..	3,230	5,787	134	9,150	9,490	21,630
June ..	2,993	6,247	127	9,366	8,489	20,783
July ..	3,068	6,646	126	9,840	8,443	19,316
Aug. ..	3,214	6,488	130	9,833	8,917	18,477
Sept. ..	1,688	5,902	133	7,723	8,641	19,393
Oct. ..	2,620	5,351	182	8,154	9,708	20,985
Nov. ..	3,516	3,876	121	7,513	7,636	18,803

Source: The Rubber Manufacturers Association, Inc.

U.S.A. Rubber Industry Employment, Wages, Hours

Year	Production Workers (1000's)	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings	Consumer's Price Index
		All Rubber Products			
1939	121	$27.84	39.9	$0.75	
1955	214.7	87.15	41.7	2.09	114.5
1956					
July	202.8	85.75	39.7	2.16	117.0
Aug.	205.5	87.23	40.2	2.17	116.8
Sept.	209.9	89.10	40.5	2.20	117.1
Oct.	214.5	89.98	40.9	2.20	117.7
Nov.	194.4	87.89	40.5	2.17	117.8
Dec.	215.8	92.74	41.4	2.24	118.0
1957					
Jan.	216.0	91.21	40.9	2.23	118.2
Feb.	212.6	90.80	40.9	2.22	118.7
Mar.	211.4	89.28	40.4	2.21	118.9
Apr.	191.3	87.60	40.0	2.19	119.3
May	204.6	88.80	40.0	2.22	119.6
June	196.8	91.21	40.9	2.23	120.2
July	199.9	94.16	41.3	2.28	120.8
Aug.	204.3	92.84	40.9	2.27	121.0
Sept.	206.4	93.02	40.8	2.28	121.1
Oct.	207.2	....	...	...	121.1
		Tires and Tubes			
1939	54.2	$33.36	35.0	$0.96	
1955	88.6	101.09	41.6	2.43	
1956					
July	84.7	98.14	39.1	2.51	
Aug.	84.4	101.20	40.0	2.53	
Sept.	86.0	102.51	40.2	2.55	
Oct.	86.0	102.66	40.1	2.56	
Nov.	70.1	103.53	40.6	2.55	
Dec.	87.3	109.25	41.7	2.62	
1957					
Jan.	87.4	107.64	41.4	2.60	
Feb.	86.8	106.19	41.0	2.59	
Mar.	86.9	102.40	40.0	2.56	
Apr.	71.1	103.46	40.1	2.58	
May	84.9	103.46	40.1	2.58	
June	78.2	107.23	41.4	2.59	
July	84.4	112.20	42.5	2.64	
Aug.	84.2	107.83	41.0	2.63	
Sept.	84.5	107.33	40.5	2.65	
		Rubber Footwear			
1939	14.8	$22.80	37.5	$0.61	
1955	18.2	70.70	40.4	1.75	
1956					
July	19.0	71.28	39.6	1.80	
Aug.	19.3	70.35	39.3	1.79	
Sept.	19.4	71.71	39.4	1.82	
Oct.	19.3	71.71	39.4	1.82	
Nov.	18.9	71.55	39.1	1.83	
Dec.	18.6	73.26	39.6	1.85	
1957					
Jan.	18.3	71.76	39.0	1.84	
Feb.	17.8	72.10	39.4	1.83	
Mar.	17.8	72.86	39.5	1.84	
Apr.	17.5	70.64	38.6	1.83	
May	17.3	71.92	39.3	1.83	
June	17.4	72.29	39.5	1.83	
July	16.9	72.13	39.2	1.84	
Aug.	17.2	73.05	39.7	1.84	
Sept.	17.5	74.64	39.7	1.84	
		Other Rubber Products			
1939	51.9	$23.34	38.9	$0.61	
1955	107.9	78.35	41.9	1.87	
1956					
July	99.1	77.78	40.3	1.93	
Aug.	101.8	78.76	40.6	1.94	
Sept.	104.5	81.18	41.0	1.98	
Oct.	109.2	82.98	41.7	1.99	
Nov.	105.4	79.98	40.6	1.97	
Dec.	109.9	82.59	41.5	1.99	
1957					
Jan.	110.3	81.39	40.9	1.99	
Feb.	108.0	81.18	41.0	1.98	
Mar.	106.7	81.19	40.8	1.99	
Apr.	102.7	79.60	40.2	1.98	
May	102.2	79.80	40.1	1.99	
June	101.2	81.81	40.7	2.01	
July	98.6	82.62	40.7	2.03	
Aug.	102.9	83.84	41.1	2.04	
Sept.	104.4	84.87	41.2	2.06	

Source: BLS, United States Department of Labor.

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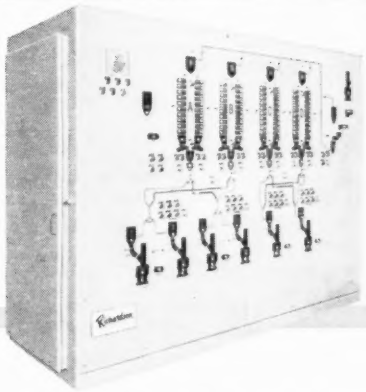

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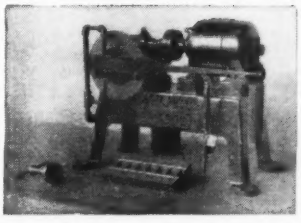

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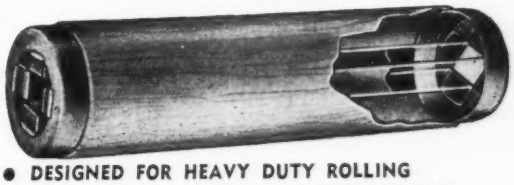

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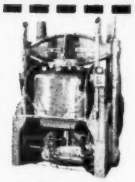
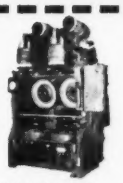


Model 900-75-25D BAG-O-MATIC Tilt-Back

Model 450-55-16D BAG-O-MATIC Tilt-Back



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Model 300-47½-11½D BAG-O-MATIC

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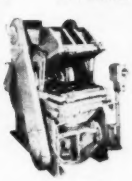
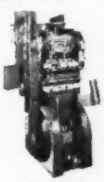
Model 800-32 With Ejector



Model 800-32 Intermediate Platen

Model 300 Transfer Molding Press



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Index to Advertisers

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A

Adamson United Co. 691
Aetna-Standard Engineering Co. ..... —
Albert, L., & Son 786
Aluminum Flake Co. 786
American Cyanamid Co., Rubber Chemicals Dept. 771
American Synthetic Rubber Corp. 765
American Zinc Sales Co. ..... Third Cover
Ames, B. C., Co. ..... —
Amoco Chemicals Corp. ..... —

B

Barco Manufacturing Co. 644
Black Rock Mfg. Co. ..... —
Bolling, Stewart, & Co., Inc. ..... —
Brockton Tool Co. ..... —
Brooklyn Color Works, Inc. 768

C

Cabot, Godfrey L., Inc. ..... Back Cover
Cambridge Instrument Co., Inc. 764
Carter Bell Mfg. Co., The 760
Cellusuede Products, Inc. 768
Claremont Flock Corp. 777
CLASSIFIED ADVERTISEMENTS 784-786
Cleveland Liner & Mfg. Co., The 650
Columbia-Southern Chemical Corp. ..... —
Columbian Carbon Co. ..... Insert 729, 730
Mapico Color Unit ..... —
CONSULTANTS & ENGINEERS 786
Continental Carbon Co. 769
Continental Machinery Co., Inc. 785
Copolymer Rubber & Chemical Corp. 667
Cylinder Manufacturing Co. 785

D

Darlington Chemicals, Inc. 766
Dayton Rubber Co. 777
Diamond Alkali Co. 660
Dow Corning Corp. 759
DPR Incorporated, A Subsidiary of H. V. Hardman Co. 779
du Pont de Nemours, E. I., & Co. ..... Second Cover
Durez Plastics Division, Hooker Electrochemical Co. ..... —

E

Eagle-Picher Co., The 777
Eastern States Petroleum & Chemical Corp. 659
Eastman Chemical Products, Inc. 675
English Mica Co., The ..... —
Enjay Co., The 755
Erie Engine & Mfg. Co. 682
Erie Foundry Co. 652

F

Falls Engineering & Machine Co., The ..... —
Farrel-Birmingham Co., Inc. ..... —
Ferry Machine Co. 783
Flexo Supply Co., The 784
French Oil Mill Machinery Co., The 762

G

Gammeter, W. F., Co., The 768
General Tire & Rubber Co., The (Chemical Division) 664, 665
Genseke Brothers 761
Gidley Laboratories, Inc. ..... —
Glidden Co., The (Chemicals, Pigments, Metals Division) ..... —
Goodrich, B. F., Chemical Co. 639
Goodrich-Gulf Chemicals, Inc. 674
Goodyear Tire & Rubber Co., Inc., The (Chemical Division) ..... Insert 647, 648; 649

H

Hale & Kullgren, Inc. 786
Hall, C. P., Co., The 656
Harchem Division, Wallace & Tiernan, Inc. ..... —
Harshaw Chemical Co., The 645
Harwick Standard Chemical Co. 671
Hoggson & Pettis Mfg. Co., The ..... —
Holliston Mills, Inc., The ..... —
Holmes, Stanley H., Co. ..... —
Houston Rubber Machine Co. 786
Howe Machinery Co., Inc. 786
Huber, J. M., Corp. 692

I

Iddon Brothers, Ltd. 686
Independent Die & Supply Co. ..... —
Industrial Ovens, Inc. 753
Institution of the Rubber Industry 678

J

Jefferson Chemical Co., Inc. ..... —
Johnson Corp., The 781

K

K. B. C. Industries, Inc. 786
Kenrich Corp. ..... —

L

Lambert, E. P., Co. 684
Liquid Carbonic, Division of General Dynamics Corp. ..... —
Litzler, C. A., Co., Inc. 690

M

Mapico Color Unit, Columbian Carbon Co. ..... —
Marbon Chemical Division of Borg-Warner Corp. 670
McNeil Machine & Engineering Co., The 785
Merck & Co., Inc., Marine Magnesium Division ..... —
Midwest Rubber Reclaiming Co., Custom Mixing Division ..... —
Monsanto Chemical Co. ..... —
Morris, T. W., Trimming Machines 682
Muehlstein, H., & Co., Inc. 643

N

National Aniline Division, Allied Chemical & Dye Corp. 673
National Rosin Oil Products, Inc. ..... —
National Rubber Machinery Co. ..... —
National Standard Co. 681
Naugatuck Chemical Division of U. S. Rubber Co. ..... Insert 679, 680
Neville Chemical Co. 685
New Jersey Zinc Co., The 646

O

Oakite Products, Inc. ..... —

P

Pennsalt Chemicals Corp., Industrial Division ..... —
Pennsylvania Industrial Chemical Corp. 690
Phillips Chemical Co. 642, 763
Polymel Corp., The ..... —
Polymer Corp., Ltd. ..... —

R

Rand Rubber Co. 786
Rare Metal Products Co. ..... —
Richardson, Sid, Carbon Co. 788
Richardson Scale Co. 783
Roebling's, John A., Sons Corp. 669
Royle, John, & Sons 684
Rubber & Asbestos Corp. 768
Rubber Corp. of America 781
Rubber Regenerating Co., Ltd., The 767

S

St. Joseph Lead Co. 672
Sargent's, C. G., Sons Corp. ..... —
Schaefer Machine Co., Inc. 764
Schlosser, H. A., & Co. 786
Scott Testers, Inc. 785
Scovill Manufacturing Co. 651
Shaw, Francis, & Co., Ltd. 662
Shell Chemical Corp., Synthetic Rubber Sales Division 683
Sherman Rubber Machinery Co. 785
Shore Instrument & Manufacturing Co., Inc., The 786
Silicones Division, Union Carbide Corp. 655
South Texas Tire Test Fleet, Inc. ..... —
Southeastern Clay Co. ..... —
Southern Clays, Inc. 676
Spadone Machine Co., Inc. ..... —
Stamford Rubber Supply Co., The 781
Sun Oil Co. 757

T

Taylor Instrument Cos. ..... —
Taylor, Stiles & Co. 779
Texas—U. S. Chemical Co. 653
Thiokol Chemical Corp. 677
Thomaston Mills 766
Timken Roller Bearing Co., The ..... —
Titanium Pigment Corp. ..... —
Torrington Co., The 666
Turner Halsey Co. 772

U

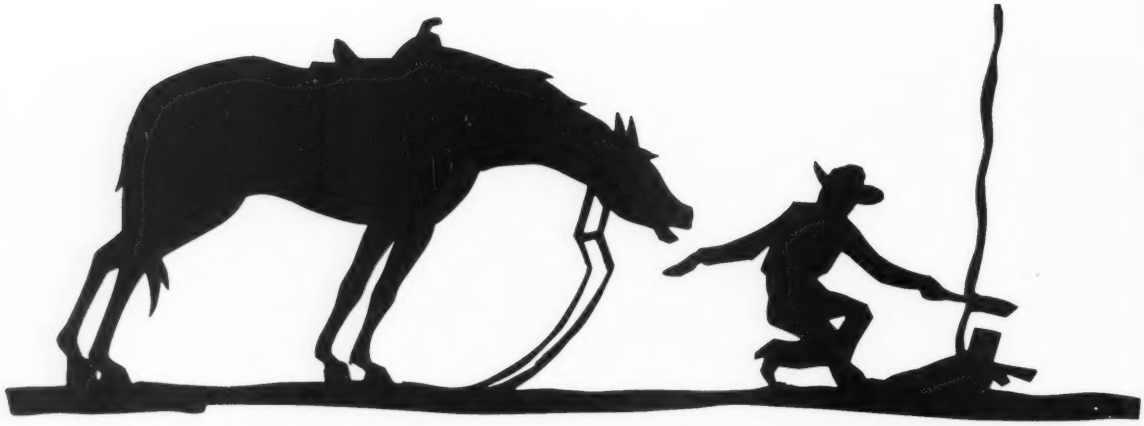
Union Carbide Chemicals Co., Division of Union Carbide Corp. 678, 687
Union Carbide Corp:
Silicones Division 655
Union Carbide Chemicals Divison 678, 687
United Carbon Co., Inc. ..... Insert 657, 658
United Engineering & Foundry Co. 661
United Rubber Machinery Exchange 784
U. S. Rubber Reclaiming Co., Inc. ..... —
Universal Oil Products Co. 654

V

Vanderbilt, R. T., Co., Inc. 694
Velsicol Chemical Corp. 663

W

Wade, L. C., Co., Inc. 786
Wellington Sears Co. 775
Wellman Co. 786
Western Supplies Co. 779
White, J. J., Products Co. 686
Williams, C. K., & Co., Inc. 758
Witco Chemical Co. 769
Woloch, George, Co., Inc. 783
Wood, R. D., Co. 668



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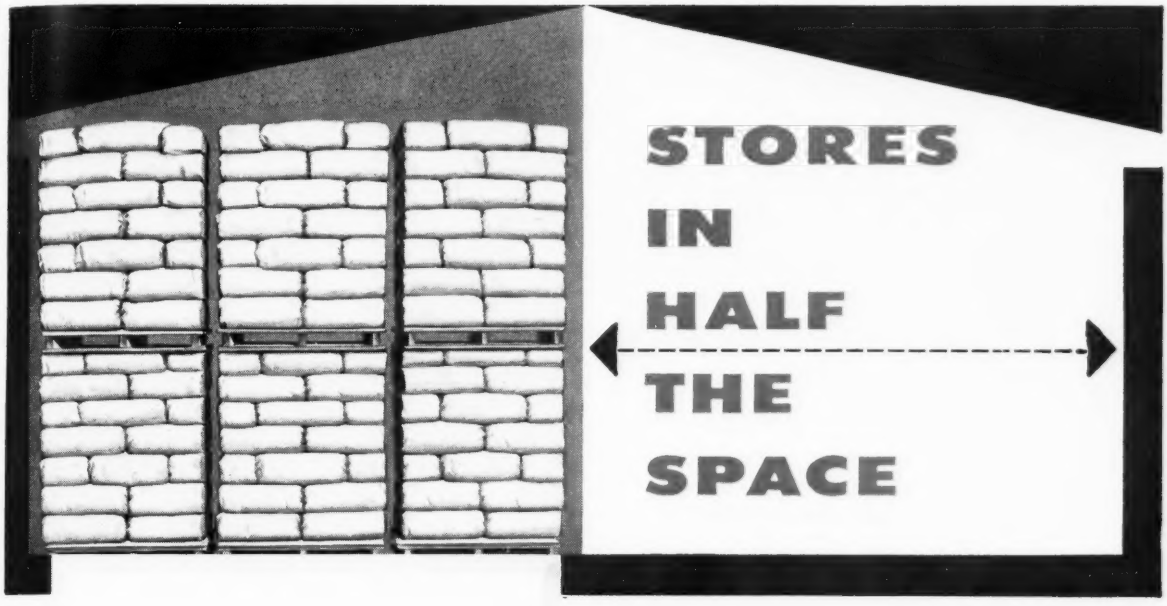

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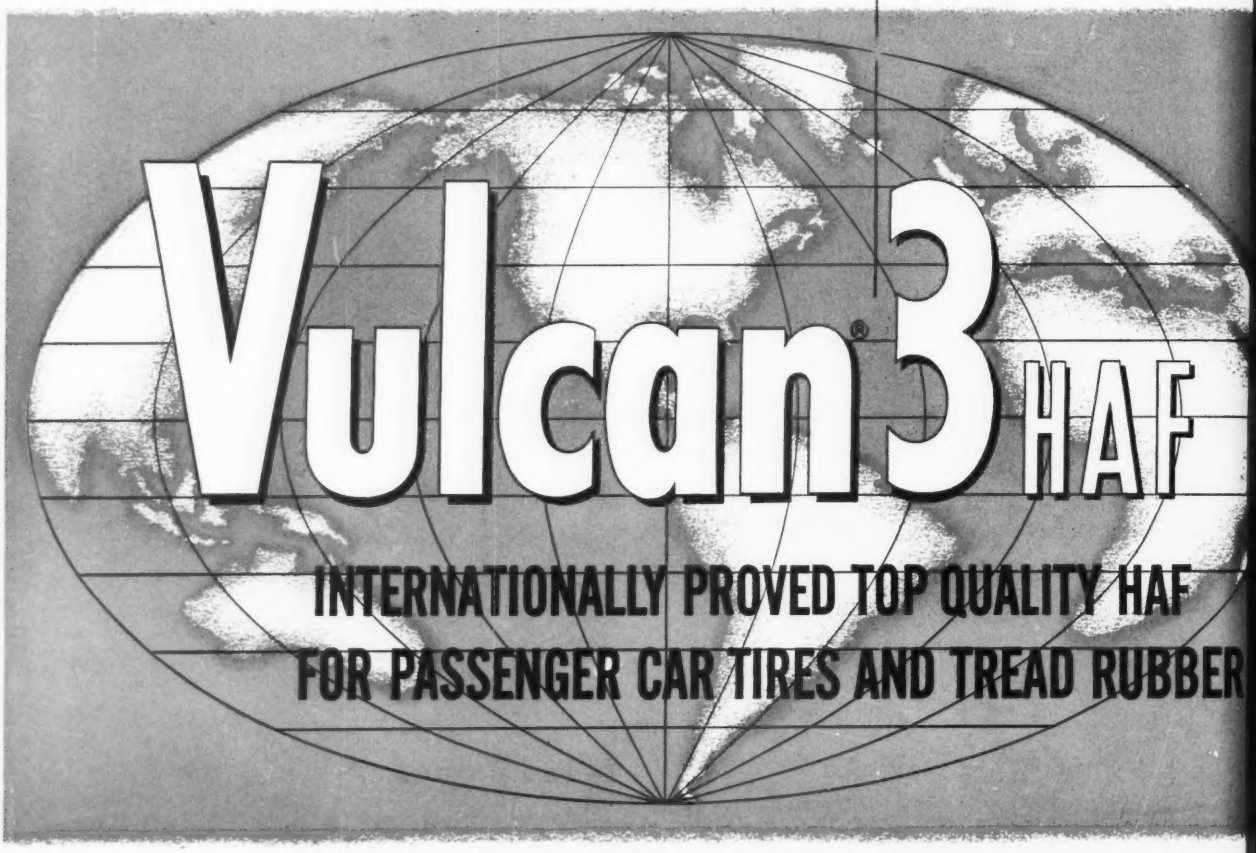

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